Forest Insect and Disease Conditions in Canada 1985

Canada

87-01971/

©Minister of Supply and Services Canada 1986
Catalogue No. Fo 21-1/1985E
ISBN 0-662-14890-8
ISSN 0226-9759

Additional copies of this publication may be obtained from
Canadian Forestry Service
Place Vincent Massey, 3rd Floor
Ottawa, Ontario
K1A 0C5

A microfiche edition of this publication
may be purchased from
Micromedia Ltd.
158 Pearl Street
Toronto, Ontario
M5H 1L3

Cette publication est aussi disponible en français sous le titre *Insectes et maladies des arbres au Canada 1985*.

Cover: FIDS–PFC ranger Leo Unger hanging a pheromone trap.

Forest Insect and Disease Conditions in Canada 1985

Compiled by E.S. Kondo and R.G. Taylor in cooperation
with officers of forestry establishments, as follows:

Newfoundland Forestry Centre

J. Hudak
L.J. Clarke
G.C. Carew

Canadian Forestry Service - Maritimes

L.P. Magasi
E.G. Kettela
D.P Ostaff
B.A. Pendrel
F.A. Titus

Laurentian Forestry Centre

D. Lachance

Petawawa National Forestry Institute

J.M. Power

Great Lakes Forestry Centre

G.M. Howse
P.D. Syme
H.L. Gross
D.T. Myren
M.J. Applejohn
K.L. Nystrom
J.H. Meating

Northern Forestry Centre

B.H. Moody
H.F. Cerezke

Pacific Forestry Centre

G.A. Van Sickle
C.S. Wood

Forest Insect and Disease Survey
Canadian Forestry Service
Ottawa, 1986

Addresses of the Canadian Forestry Service:

Headquarters

Location:	Mailing Address:
Place Vincent Massey 19th Floor 351 St. Joseph Blvd. Hull, Quebec	Canadian Forestry Service Government of Canada Ottawa, Ontario K1A 1G5

Forestry Establishments

Newfoundland Forestry Centre
Canadian Forestry Service
P.O. Box 6028, Bldg. 304
Pleasantville
St. John's, Newfoundland
A1C 5X8

Canadian Forestry Service – Maritimes
P.O. Box 4000, College Hill
Fredericton, New Brunswick
E3B 5P7

Laurentian Forestry Centre
Canadian Forestry Service
P.O. Box 3800, 1055 rue du P.E.P.S.
Sainte-Foy, Quebec
G1V 4C7

Petawawa National Forestry Institute
Canadian Forestry Service
Chalk River, Ontario
K0J 1J0

Great Lakes Forestry Centre
Canadian Forestry Service
P.O. Box 490, 1219 Queen Street East
Sault Ste. Marie, Ontario
P6A 5M7

Northern Forestry Centre
Canadian Forestry Service
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

Pacific Forestry Centre,
Canadian Forestry Service
506 West Burnside Road
Victoria, British Columbia
V8Z 1M5

Forest Pest Management Institute
Canadian Forestry Service
P.O. Box 490, 1219 Queen Street East
Sault Ste. Marie, Ontario
P6A 5M7

Contents

5 **Introduction**

7 **Major Forest Insects and Diseases**
- 7 Spruce budworm
- 13 Western spruce budworms
- 14 Jack pine budworm
- 16 Mountain pine beetle
- 18 Spruce beetle
- 20 Eastern larch beetle
- 20 Gypsy moth
- 24 Forest tent caterpillar
- 27 Hemlock looper
- 29 Dutch elm disease
- 29 Scleroderris canker
- 32 European larch canker
- 33 Dwarf mistletoes
- 34 Decline and dieback and stress-related disorders

36 **Acid Rain National Early Warning System**

41 **Special Surveys**
- 41 Cone and seed pests
- 44 Pests in young stands and plantations
- 47 Pinewood nematode
- 50 Root and butt rots

52 **Other Insects, Diseases, and Damage**
- 52 Newfoundland region
- 56 Maritimes region
- 64 Quebec region
- 68 Ontario region
- 82 Western and Northern region
- 85 Pacific and Yukon region

93 **Selected Bibliography**

101 **Index to Insects, Diseases, and Damage**

Introduction

In 1986 the Forest Insect and Disease Survey is celebrating 50 yr of service to the needs of forestry in Canada. The forest insect survey was formally established in 1936 to fulfill a growing need for information and extension services. Its origin was closely related to the severe European spruce sawfly outbreak in Eastern Canada and its primary objective was to follow the population level and spread of this one insect. From this small beginning the survey rapidly expanded to include forest insects generally. In 1951 the Forest Biology Division (Science Service) was organized to coordinate all activities of the Science Service relating to forestry. The division consisted of two principal units: forest zoology and forest pathology. In 1951 the name Forest Insect and Disease Survey was adopted.

Today the Forest Insect and Disease Survey is a nationally coordinated program of six regional FIDS units and the new FIDS Technology Development Project. Activities are managed by the regional CFS establishments. The program provides perspectives on insects and disease, including acid rain, to forest managers, quarantine agencies, researchers, educators, and the public.

Forest Insect and Disease Conditions in Canada 1985 is the fifth in the series of national annual reports of the Forest Insect and Disease Survey. This series replaces the *Annual Report of the Forest Insect and Disease Survey*. Since its first issue in 1981, its volume of information has doubled.

In cooperation with those responsible for improving forest inventory and economic data in Canada, the survey is attempting to provide more quantitative and interpretive data on damage and depletion caused by forest pests. The new initiative requires the development of methodologies and procedures before complete and accurate data can be made available. As forest management intensifies and the old growth forests are gradually replaced by new, managed forests, new pest problems and impacts will arise and require increased attention (for example, the spruce budworm). Accordingly, our regional and national reporting will continue to be modified to reflect the changing activities and findings of the survey.

This report is produced through a cooperative effort of the six regional establishments of the Canadian Forestry Service. We are pleased to introduce this year our new FIDS Technology Development Project. A new initiative by FIDS was made in 1985 through the establishment of a project to coordinate technology development for FIDS. Based at the Petawawa National Forestry Institute, the project will draw from the strength of resident expertise in computing, data analysis, remote sensing, and modeling for use in support of FIDS activities. The project's objectives are:

1. to plan, develop, and implement forest pest management information systems; and
2. to develop and apply new technology in data handling, analysis, remote sensing, and modeling, in cooperation with the CFS regions and the PNFI projects in these disciplines.

One of the first concerns of the project is to organize the data FIDS has amassed over the decades. The Forest Insect and Disease Survey sampling form represents the major source of historical information on the detection, location, and identification of forest pests. The form records field observations of pests, and information on the analysis of specimens. To date, over 600 000 forms have been completed and the data entered into a computer. The challenge is to provide easy access and interpretation of this historical information for FIDS researchers, rangers, survey planners, and advisers. The project has developed a system based on advanced methods of data storage and retrieval, running on the current generation of high-powered minicomputers, that will bring pest information to FIDS on demand. The system, known as FIDS INFOBASE, was developed using a relational database management system.

When the system is brought into the FIDS regional operations it will allow retrievals to be made in seconds or minutes, versus a turnaround time of weeks experienced on the system it replaces. It is designed to permit the addition of the many other types of data FIDS has or needs access to. It will evolve as new data is integrated to become a unified information system for forest pest management.

By mid-1986, the system will be able to accept and provide field data from the Acid Rain National Early Warning System (ARNEWS) network of plots. Scientists will use this database to search for trends in vegetation damage which may be associated with acid rain or other causes. Soon additional data for a FIDS information system will be investigated, including data on other ground surveys, insectary and herbarium collections, and weather.

Spatial information describing the location of infestations, survey plots, and related attributes are collected or acquired by FIDS in the form of maps and associated statistics. Efficiency and greater analysis capabilities can be offered if the handling of spatial data can be automated to some degree. For instance, mapped pest infestations can be loaded into a computer as polygons. A standard map coordinate system such as the Universal Transverse Mercator could be adopted. The polygons can be given attributes to identify the characteristics of the infestation. Such a database allows polygons to be displayed or plotted at various scales, line weights, shading patterns, or colours. They could be analyzed for the area they represent, or their relationship to other point or polygon data present in the database. Boolean operations can be made on polygons, such as overlaying consecutive years of defoliation to determine the area with the greatest probability of mortality. After other layers of data are loaded, such as forest inventory data, the impact of an infestation on the corresponding standing timber can be estimated. Systems that can handle spatial data in this way are known as "geographic information systems" (GIS); their application is being investigated by the project. Such systems are already being used in FIDS research at the Pacific Forestry Centre.

A study of the feasibility of using GIS for FIDS on a national basis has been completed. One result of the study will be the implementation of small microcomputer-based systems that will allow FIDS to get hands-on experience in computer mapping and analysis. This may be followed later with the operational use of large GIS for more sophisticated applications.

The project's initial focus, the introduction of computing into the FIDS regional operations, dictates that this task be well coordinated. The FIDS INFOBASE, ARNEWS, GIS, and other information services that are to be put in place require computer equipment, software, and training.

In this report, pests considered to be currently most significant in terms of their present or potential economic, sociological, or environmental impact are described in detail under "Major Forest Insects and Diseases." Regional surveys of pest problems in special situations or of specific pests are summarized under "Special Surveys." The status of many other pests is presented in tabular form by region under the title "Other Insects, Diseases, and Damage." This section has been expanded since 1983 to reflect the importance of these pests. Although they do not, in most cases, have spectacular effects, they are important because of their potential for expansion, quarantive considerations, and as vectors and indicators of other problems. Also, in some cases, they create losses due to their insidious nature. Additional information on these and other pests can be obtained from the regional forestry centers of the Canadian Forestry Service.

There are several insidious forest pests in Canada that are not amenable to routine detection surveys and therefore not to annual census; nevertheless, they do cause significant losses. Root rots and mistletoes are but two examples of this type of pest. This report recognizes the importance of these pests through periodic descriptive if not quantitative reviews of these pest types.

When possible in this report we use current nomenclature and authorship to designate pest species. Because the taxonomy of some species changes occasionally and old names tend to persist after a change, we strive to realistically balance clear communication to our audience and incorporation of taxonomic revision.

In recent years we have personalized the cover of this report by showing some of our rangers in action. This year one of our Pacific Forestry Centre rangers, Leo Unger, is shown hanging a pheromone trap. He is wearing the unofficial FIDS crest, a stylized optical illusion which represents an insect (weevil) to an entomologist and a mushroom to a pathologist.

In addition to those already named we would like to acknowledge the field and laboratory staffs of the forestry centers; officers of provincial and federal governments and agencies; the forest industry; private individuals; and especially the assistance provided by Mrs. J. Tomlinson, chief of the Scientific and Technical Publications Division. Finally, we thank those who provided us with comments and suggestions on previous reports.

E.S. Kondo
Director, Forest Insect and Disease Survey

R.G. Taylor
Scientific Advisor

B.A. Pendrel
Regional Advisor, 1985

Major Forest Insects and Diseases

Spruce budworm

Choristoneura fumiferana (Clem.)

This insect remains Canada's most destructive forest pest. In 1985 the total area of moderate to severe defoliation by the spruce budworm increased to 20.2 million ha (Fig. 1). The relatively low 1984 levels increased throughout the Maritime provinces. Defoliated areas in Nova Scotia and Prince Edward Island were each about four times greater than in the previous year, although in New Brunswick the defoliated area remained below the 1983 level. In Ontario the infestation in the northwestern part of the province increased substantially, merging with that in the north-central, northeastern, and northern regions. The Newfoundland outbreak, however, virtually collapsed and in Quebec defoliation declined by about 20%.

Balsam fir is the preferred host of the spruce budworm although it feeds heavily on red spruce, white spruce, and to a lesser extent on black spruce. At very high population levels, the spruce budworm will attack hemlock and larch.

In some areas, other insects and diseases such as the spruce beetle and Armillaria root rot have increased rapidly in stands weakened by repeated budworm defoliation and, in turn, have themselves attacked and killed trees. These are discussed later in this report.

A complete survey of dead and dying trees was not conducted in 1985; however, some regions have reported updated figures. In particular, Ontario reported an increase in the area exhibiting mortality.

Aerial spray operations were carried out in all provinces from Ontario eastward, except for Prince Edward Island, covering a total of 1.5 million ha (Fig. 2). Table 1 shows the areas defoliated and areas sprayed to control the spruce budworm by province in 1985. Table 2 shows the areas defoliated and sprayed since 1980.

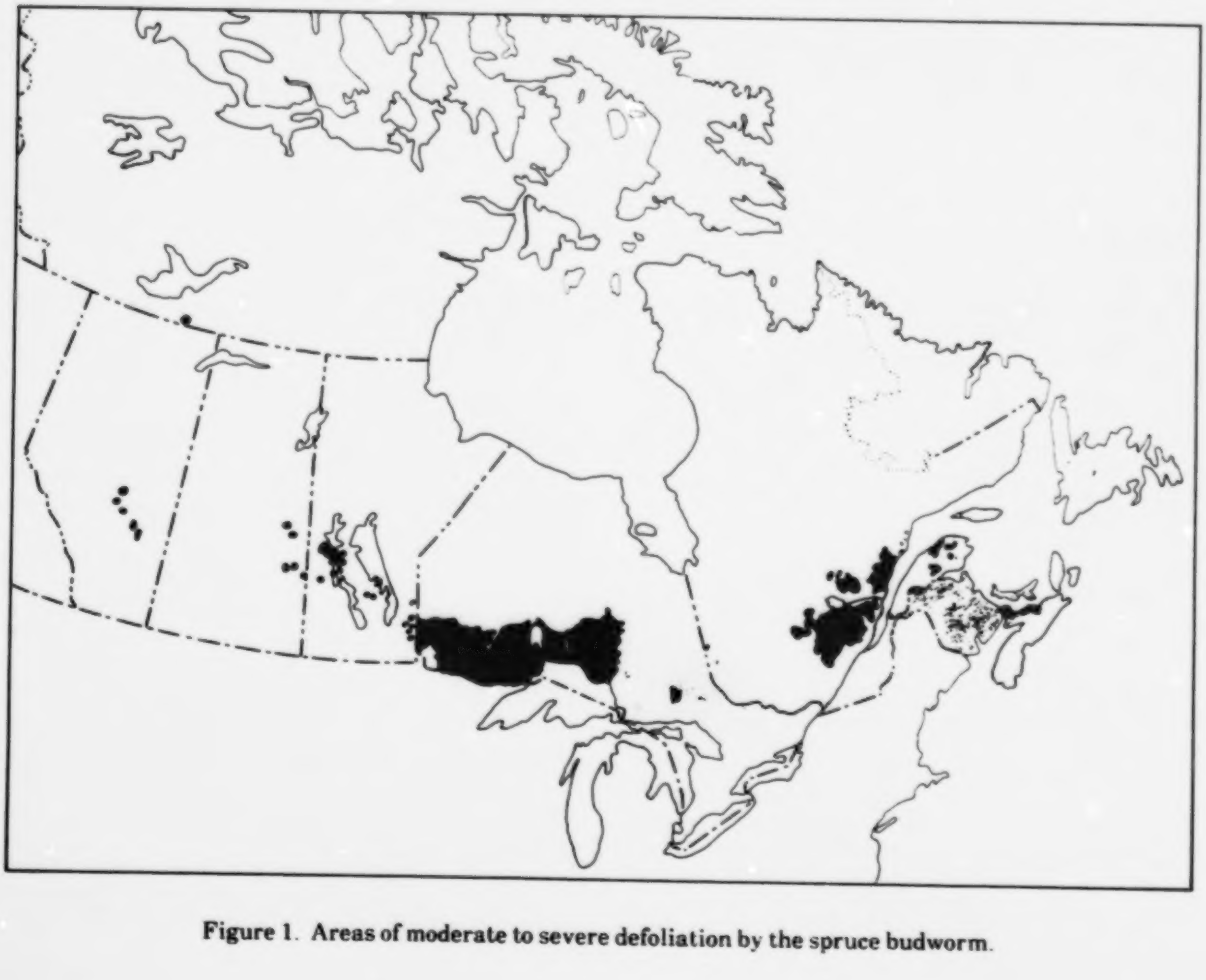

Figure 1. Areas of moderate to severe defoliation by the spruce budworm.

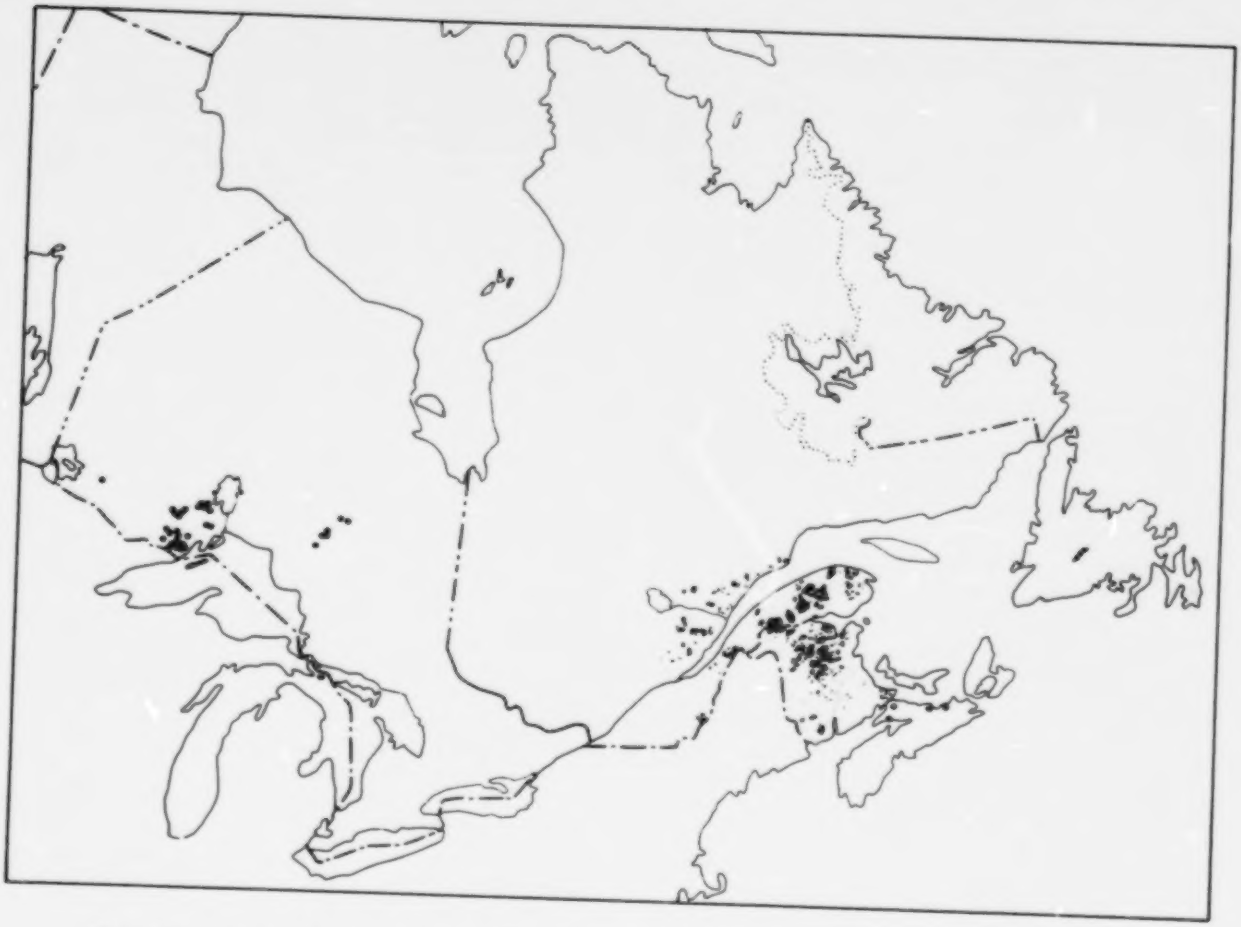

Figure 2. Locations of aerial spray operations against the spruce budworm in Eastern Canada.

Table 1. Areas of moderate to severe defoliation and aerial spraying to control the spruce budworm by province in 1985

Province	Area of moderate to severe defoliation ('000 ha)	Area sprayed ('000 ha)
Newfoundland	0.5	3.5
Prince Edward Island	53.8	0.0
Nova Scotia	318.8	52.5
New Brunswick	1 070.0	725.3
Quebec	6 290.0	667.4
Ontario	12 332.4	29.0
Prairie provinces	93.5	0.0
Total	20 159	1 477.7

Table 2. Areas of moderate to severe defoliation and aerial spraying to control the spruce budworm since 1980 in Canada

Year	Area of moderate to severe defoliation ('000 000 ha)	Area sprayed ('000 000 ha)
1980	36.2	1.9
1981	37.0	2.9
1982	18.2	3.0
1983	23.8	3.1
1984	16.8	2.0
1985	20.2	1.5

Newfoundland

Defoliation — The total area of light, moderate, and severe defoliation forecast on the island for 1985 was about 63 000 ha, about 29 300 ha in the moderate and severe category. However, the decreasing outbreak virtually collapsed in 1985. The area of infestation in 1985 was about 3500 ha, 3000 ha in the light and 500 ha in the moderate and severe category. This is a decrease from the 7300 ha of light and 15 300 ha of moderate and severe recorded in 1984. The defoliation was distributed in isolated areas mainly in western Newfoundland and one small area in central Newfoundland. There was no defoliation recorded in Labrador in 1985.

Sex pheromone traps distributed throughout the island in1985 showed many moths collected in traps near Sally's Cove on the northern peninsula and near Grand Lake in western Newfoundland. It was not determined whether the moths were flights from other provinces or a buildup of local populations.

Control — The provincial Department of Forest Resources and Lands conducted an aerial control program against the budworm and treated 3450 ha with *Bacillus thuringiensis* (*B.t.*). In 1985 samples of spruce budworm were collected from five areas across the island to assess natural mortality factors. The major larval parasites were *Apanteles fumiferanae*, *Glypta fumiferanae*, and a tachinid species. The major pupal parasite was *Phaeogenes hariolus*. About 17% of spruce budworm larvae were parasitized. Fungal pathogens caused about 1% mortality of the reared budworm larvae. The fungal pathogens were *Paecilomyces farinosus*, *Entomophaga aulicae*, and a single incidence of *Hirsutella gigantea*. Microsporidian disease caused by *Nosema fumiferanae* was observed at only one location and infection was less than 1%.

Damage — Detailed assessment of damage at the inventory level is conducted by the Department of Forest Resources and Lands. However, less intensive surveys by the Forest Insect and Disease Survey showed that the balsam fir and black spruce stands with more than 10% tree mortality did not increase from 1984. The total volume of these stands was estimated at 40.4 million m^3 and 10.3 million m^3, respectively. The foureyed spruce bark beetle, *Polygraphus rufipennis*, and Armillaria root rot, *Armillaria mellea*, were associated with dying trees in black spruce stands previously defoliated by the spruce budworm. Permanent plots were established to monitor the progress of mortality and the role of these secondary organisms. The rate of tree mortality in mature black spruce stands decreased again in 1985 to an average of 3.2% from 4.5% in 1984 and 8.7% in 1983. The corresponding decrease in immature spruce stands is 1.2% in 1985, 2% in 1984, and 5% in 1983. The decrease in the rate of black spruce mortality is consistent with the decline of bark beetle activity, and the surviving spruce trees may recover.

Forecast — Egg and overwintering larval samples were collected in conjunction with the egg survey of the hemlock looper in late October. Because of the results of this survey, no moderate and severe defoliation is expected for 1986 on the island. Light defoliation is forecast to occur on about 7500 ha distributed in four widely isolated areas, three on the west coast of the island and one in central Newfoundland.

Nova Scotia

Defoliation — Defoliation of balsam fir and spruce in softwood and mixed-wood stands occurred on 345 200 ha in Nova Scotia in 1985. Defoliation was severe on 286 700 ha, moderate on 32 100 ha, and light on 26 400 ha. The severe defoliation class includes 280 100 ha where moderately defoliated patches were interspersed throughout severely defoliated areas. The 318 800 ha of severe and moderate defoliation represents a fivefold increase from the 58 700 ha in these categories reported in 1984 and is also considerably higher than the 294 000 ha so affected in Nova Scotia in 1983. The previously identified outbreak areas are discussed briefly.

In Cumberland–Colchester counties defoliation was severe or moderate on 179 700 ha in 1985. In the adjacent counties of Pictou and Antigonish on the Northumberland Strait coast, severe or moderate defoliation was recorded on 139 100 ha in 1985. No severe or moderate defoliation occurred in either the Annapolis Valley–Hants County area or on Cape Breton Island in 1985, a situation similar to that found in 1984.

Damage — No specific province-wide damage surveys for spruce budworm were conducted by the Forest Insect and Disease Survey in Nova Scotia in 1985. However, the results of a regional assessment of the fir–spruce forest (see "Special Surveys") are relevant because spruce budworm is one of the main causes of tree mortality in the fir–spruce ecosystem. In addition, we continued monitoring tree mortality on research plots on Cape Breton Island in the aftermath of the spruce budworm devastation and also conducted a special damage assessment survey in the Cumberland–Colchester area, in cooperation with the Nova Scotia Department of Lands and Forests.

Since 1976 mortality of merchantable balsam fir has been followed on permanent research plots on both the highland and lowland areas of Cape Breton Island. Although spruce budworm populations have decreased drastically from those at the height of the outbreak, losses increased when many of the weakened trees were killed by a complex of secondary organisms, and in recent years by blowdown.

On the highlands, 85.7% of the original trees had been lost by the fall of 1985, an increase of 2.4% since 1984. On the lowlands, mortality and blowdown by 1985 amounted to 92.4% on the research plots, no change from 1984. The apparent slowdown in losses results from the high levels of stand destruction; that is, there are fewer trees to die.

An aerial damage survey, conducted jointly with the Nova Scotia Department of Lands and Forests in Colchester, Cumberland, and Pictou counties, was concentrated in those areas where defoliation was consistently moderate or severe in recent years. Detailed analysis of the data is not yet available but preliminary results show the proportion of gray trees, indicating dead or dying softwood trees, over Cumberland, Colchester, and Pictou counties, Nova Scotia, in 1985 as follows:

Proportion of softwood component "gray"	Area flown so affected
71% or more	less than 1%
41–70%	2%
11–40%	28%
0–10%	70%

Control — Operations in Nova Scotia were conducted by the Nova Scotia Department of Lands and Forests on 49 720 ha and by J.D. Irving Ltd. on 2800 ha, a total of 52 520 ha in 1985. The biological control agent *B.t.* (Dipel® 132) was applied at 20 BIU/ha to 8570 ha and at 30 BIU/ha to 41 150 ha by the provincial agency, and at 30 BIU/ha to 2800 ha by J.D. Irving Ltd. All areas were treated in a single application.

Forecast — Overwintering larval surveys (L_2), conducted by the provincial Department of Lands and Forests, replaced the traditional egg-mass surveys for the first time in Nova Scotia and results from these constitute the sole base from which predictions are made.

Information from 362 locations shows that infestations for 1986 are negative or low in 11 of the counties. A single location in each of Digby, Inverness, and Victoria counties was found to be moderate. Of the 86 locations distributed in Cumberland, Colchester, Pictou, and Antigonish counties, infestations are moderate on 37%, high on 20%, and extreme on 43%. The spruce budworm outbreak is expected to remain intensified and concentrated in central Cumberland County and along the Northumberland Strait coast.

Prince Edward Island

Defoliation — Defoliation of balsam fir and spruce stands occurred throughout Prince Edward Island and affected 70 100 ha in 1985. Defoliation was severe on 41 000 ha, moderate on 12 800 ha, and light on 16 300 ha (Fig. 1). The severe defoliation class includes 40 000 ha where moderately defoliated patches were interspersed throughout severely defoliated areas. The more than fourfold increase in the area of detectable defoliation over the 15 600 ha recorded in 1984 could be partly, but not entirely, the result of an underestimation of the affected area in 1984 due to extremely unfavorable weather conditions before the survey period.

Damage — There were no specific damage surveys for spruce budworm conducted by the Forest Insect and Disease Survey in 1985. However, the results of a regional assessment of the fir–spruce forest and the stand mortality survey in the province (see "Special Surveys") are relevant because spruce budworm is one of the main causes of tree mortality in the fir–spruce ecosystem.

Control — No control measures on an operational scale were carried out against the spruce budworm in Prince Edward Island.

Forecast — The L_2 survey was used in Prince Edward Island for the first time in 1984 to predict populations for the following year. In 1985 the L_2 survey included 55 locations throughout the province of which 9% are in the extreme, 33% in the high, 29% in the moderate, and 29% in the low or negative infestation category. The hazard index, taking into consideration the expected spruce budworm population, previous defoliation, and tree condition, indicates that 12% of the locations assessed are in the high, 20% in the moderate, and 68% in the low hazard categories. The high hazard areas are in southern Queens and Kings counties and in parts of Prince County, where continued moderate or severe defoliation would most likely result in tree mortality.

New Brunswick

Defoliation — Defoliation of balsam fir and spruce stands was recorded as severe or moderate over 1.070 million ha in the province in 1985. Inclement weather before aerial surveys resulted in the loss of much reddened foliage from the trees, necessitating combining moderate and severe defoliation categories and preventing accurate mapping of the light defoliation class. Consequently, the "traditional" area of total defoliation is not available for the 2nd consecutive year.

The 1.070 million ha severe and moderate defoliation caused by the spruce budworm in 1985 is a significant increase over the area so affected in 1984 (730 000 ha), but is only half of the 2.028 million ha recorded in those categories in 1983.

Damage — There were no specific damage surveys for spruce budworm conducted by the Forest Insect and Disease Survey in 1985. However, the results of a regional assessment of the fir–spruce forest (see "Special Surveys") are relevant because spruce budworm is one of the main causes of tree mortality in the fir–spruce ecosystem.

Control — Foliage protection against the spruce budworm in New Brunswick was conducted over 725 250 ha in 1985, 701 000 ha by Forest Protection Ltd., and 24 250 ha by Forest Patrol Ltd., a subsidiary company of J.D. Irving Ltd., Saint John, N.B. Forest Protection Ltd. treated 452 000 ha with aminocarb (Matacil® 180 F) in two applications at 70 g/ha per application, and 168 000 ha with fenitrothion (Sumithion®) at 210 g/ha per application. Most of these areas were treated twice. Both chemicals were applied in water-based formulations. In addition, the biological insecticide *B.t.* was applied undiluted at 30 BIU/ha to 81 000 ha in a single application (Dipel® 132) on 78 000 ha and Thuricide® 48 LV on 3000 ha. Forest Patrol Ltd. treated 24 000 ha with fenitrothion at 210 g/ha in a water-based solution in two applications and 250 ha with *B.t.* (Dipel® 132) at 30 BIU/ha in a single application.

Forecast — The traditional egg-mass surveys for predicting spruce budworm infestation levels were replaced by the L_2 survey in New Brunswick in 1985. The New Brunswick Department of Forest, Mines and Energy processed samples from 1521 locations. Of these, 185 locations (12%) are in the high, 503 locations (33%) in the moderate, and 833 locations (55%) in the low infestation categories. These results indicate that severe or moderate infestations might be expected over 3.15 million ha in New Brunswick in 1986. This is somewhat lower than the 3.75 million ha predicted for 1985 and follows the decreasing trend observed since 1982 when the infested area in the moderate and severe categories was predicted to be 5.30 million ha. In terms of overall distribution, much of the moderate and high populations are expected to occur in large patches across the northern part of the province and in a large band across the south–central areas and towards the southeast.

Quebec

Defoliation — The infestation covered 9.26 million ha in 1985, compared with 11.04 million ha in 1984. Damage was light over 2.97 million ha, moderate over 0.81 million ha, and severe over 5.48 million ha.

The spruce budworm infestation continued to decrease in many areas of Quebec in 1985, particularly in the administrative regions of Abitibi–Témiscamingue, the Eastern Townships, Quebec City, Gaspé Peninsula–Bas-Saint-Laurent, as well as on Anticosti Island. Damage remained intense, however, in central Quebec, over much of Laurentides Reserve, in the Saguenay–Lac-Saint-Jean area, on the north shore, and in the central and northern coast sections of the Gaspé Peninsula. This severe damage was observed primarily in the areas where the epidemic had been particularly virulent in 1984.

In western Quebec, the budworm declined dramatically nearly throughout the Abitibi–Témiscamingue region, where it had been increasing in 1984. Infested areas had increased by 0.2 million ha in 1984, but damage in 1985 was perceptible on only 0.03 million ha; this represents a 0.29 million ha decrease from 1984.

The budworm maintained its hold over central Quebec and significant damage was again reported throughout forests covering the area bounded by Mont Tremblant Provincial Park, the Gouin Reserve, the Saguenay–Lac-Saint-Jean area, and Laurentides Reserve. Damage was generally light, however, in the Outaouais region.

North of the Saguenay–Lac-Saint-Jean area, the infestation recorded in 1985 compares with that in 1984, although the insect did spread slightly. Damage was significant in the Mistassibi, aux Rats, and Péribonca river basins as well as on vast areas between the Pipmuacan Reserve and the Saguenay River, including the La Mothe Reserve and Lake Onatchiway.

The budworm continued to decrease south and east of Laurentides Reserve. Insect populations dropped along the north shore of the St. Lawrence from Quebec City to the Escoumins River and damage was less significant than in 1984, light instead of moderate to severe.

Spruce budworm populations continued to decline along the south shore of the St. Lawrence River, from the Eastern Townships to the Gaspé Peninsula. The decline was particularly noteworthy between Sherbrooke and Rimouski, as well as in Chaleur Bay. Several small areas of severe defoliation, nevertheless, persisted south of St-Bruno-de-Kamouraska, at lakes Ste-Anne and de l'Est, and east of Lake Témiscouata. Severe damage was reported over a central area of the Gaspé Peninsula comprising the Dunière Reserve, the Nouvelle and Cascapédia river basins, and a vast area north of Chandler, between Pellegrin and the York River. The northern side of the peninsula, between Ste-Anne-des-Monts and Gaspé, also suffered severe damage: the infested area is more scattered, however, than was reported in 1984.

On the north shore, damage was significant east of the Escoumins River basin. Extensive defoliation occurred as far as Port-Cartier, and the budworm spread over vast areas between Baie-Comeau and Port-Cartier. The insect continued to decline dramatically, however, on Anticosti Island; the infested area in 1985 covers about 10 000 ha and infestation is light over more than 60% of the infested area.

Control — The Quebec Department of Energy and Resources in 1985 continued its spruce budworm aerial spraying program for the 16th yr. Since 1970, 22.9 million ha have been treated in Quebec under this program. A total of 667 418 ha of forest land in the Gaspé Peninsula–Bas-Saint-Laurent (66%), Saguenay–Lac-Saint-Jean (8%), Quebec City (13%), and north shore (13%) administrative regions were treated in 1985. Operational treatments were applied on 665 685 ha, 767 ha received experimental treatments, and 966 ha were treated in response to special requests. The chemical insecticide fenitrothion (Sumithion®) was applied on 28% of the operationally treated area, while the biological insecticide *B.t.* (Thuricide® 48 LV, Novabac® 3, and Futura®) was used on the remainder. Experimental treatments involving *B.t.* were conducted to develop new, more concentrated *B.t.* preparations (Dipel® 176, Thuricide® 64 B, Biobit® 64) and to check the effectiveness of new *B.t.* preparations (Thuricide® 48 LV with an added adhesive, Futura XLV) and of a new *B.t.* isolate (NRD-12 isolate). Two other spraying programs to protect private forests were conducted by the Fédération des producteurs de bois du Québec (5777 ha, paid for by the Quebec Department of Energy and Resources) and by the Canadian Forestry Service (30 925 ha).

Forecast — The survey of egg masses conducted in the fall of 1985 shows that spruce budworm populations will decline in all areas of Quebec in 1986. In Abitibi–Témiscamingue, the Outaouais, and the Eastern Townships, the infestation has remained very light since 1982 and the egg-mass inventory confirms that this trend will continue in 1986. Damage will also be light in the Montreal, Trois-Rivières, Quebec City, Saguenay–Lac-Saint-Jean, and Gaspé Peninsula–Bas-Saint-Laurent administrative regions, except for specific sectors where severe damage is expected. Residual population levels will remain high in certain infested areas, thus causing severe damage north of St-Donat-de-Montcalm, south of La Tuque, north of La Malbaie, south of the Rimouski Reserve, and south of Ste-Anne-des-Monts. On the north shore, severe infestation is forecast for 1986 in the area between Forestville and Sept-Îles.

(Information provided by the Insect and Disease Protection Service, Quebec Department of Energy and Resources.)

Ontario

Defoliation — The total area of moderate to severe defoliation in 1985 reached 12.332 million ha, an increase of about 3.584 million ha. The increase occurred in the northwestern part of the province where infestations in the northwestern and north–central regions merged with infestations in the Wawa and Hearst districts of the northeastern and northern regions. This formed a single, huge infestation stretching from the Manitoba border east to the Wawa–Hearst area encompassing about 12 175 220 ha. Infestations in the remainder of the province, including northeastern and southern Ontario, continued to decline. The total area of moderate to severe defoliation in these areas is now 157 145 ha.

Damage — The total area of budworm-associated tree mortality increased by about 420 000 ha in 1985 and is now about 13.936 million ha. Most of the increase occurred in the northwestern and north–central regions where the increased budworm populations of the past several years are now beginning to take their toll on balsam fir, white spruce, and to a lesser extent black spruce stands. Increases were also recorded in the Wawa and Hearst districts of the northeastern and northern regions, respectively, where budworm populations have also been increasing. The area of budworm-associated tree mortality remained constant in the remainder of the province, where populations are either static or declining.

The estimated volume loss due to budworm-associated mortality was 5.024 million m^3 in 1985. The losses consisted of 4.034 million m^3 balsam fir, 0.491 million m^3 white spruce, and 0.499 million m^3 black spruce.

Estimated volume loss due to growth loss to all species was 1.487 million m^3 in 1985. This consisted of 989 000 m^3 balsam fir, 164 000 m^3 white spruce, and 334 000 m^3 black spruce.

Control — The Ontario Ministry of Natural Resources sprayed the biological insecticide *B.t.* over a total of about 29 000 ha against spruce budworm in the Hearst, Thunder Bay, and Dryden districts. Areas treated were high value stands such as provincial parks, plantations, a moose yard, and commercial forest.

Forecast — Egg-mass counts were carried out at 506 locations in 1985. A comparison of areas sampled in 1984 and 1985 shows an overall decline of 57%. Except for the Kenora District where an increase of 25% occurred, lower numbers of egg-masses were recorded in all districts. This fact notwithstanding, counts within the major infestations between Wawa–Hearst and the Manitoba border remain sufficiently high to produce moderate to severe defoliation throughout most of the same area infested in 1985. Indeed, there may be some expansion north of the presently infested area in the form of isolated pockets. Defoliation within the older parts of the infestation will probably be reduced in 1986, although it will likely remain in the moderate to severe range. This decline may be the result of unfavourable weather conditions (cool, wet, windy) during the oviposition period, rather than a long-term trend.

In the remainder of northern Ontario, egg-mass counts continued to decline as they have for the past several years. As a result, only a few isolated pockets of moderate to severe defoliation are expected in Chapleau, Cochrane, and North Bay districts in 1986. Very low egg counts in southern Ontario indicate that little significant defoliation will occur in that area this year.

Manitoba

Defoliation — Moderate to severe defoliation occurred over a total area of 77 000 ha of white spruce–balsam fir forests in several locations in the province, compared with 153 000 ha in 1984. The decline in budworm populations was probably the result of early emergence of overwintering larvae followed by below normal temperatures in June. The decline and mortality continued in three main areas where the infestation has persisted the longest. No control program was conducted in 1985, except for the redirection of timber harvest into one infested area. Egg-mass surveys in the infested stands indicate that the population is declining, but that moderate to severe defoliation may occur in these areas in 1986.

Saskatchewan

Moderate to severe defoliation of host stands occurred in three areas in east–central Saskatchewan totalling 15 000 ha. In one infestation near Torch River most of the infested trees have been harvested. Timber harvesting is also in progress in two other areas of budworm infestations. Egg-mass counts indicate that moderate to severe defoliation may recur in two areas with current infestations.

Alberta

Light or moderate defoliation with some patches of severe defoliation of native white spruce stands occurred in six areas in central Alberta. Moderate to severe defoliation was mapped on 1500 ha of white spruce. Aerial spraying with *B.t.* (Dipel® 88) occurred in three areas including Edmonton. Chemical insecticides were also applied from the ground in Edmonton. Egg-mass surveys indicate the populations are declining slightly but moderate to severe defoliation may occur in the major infestations except one area where light to moderate defoliation may occur in 1986.

Northwest Territories

The infestation that occurred on Long Island in the Slave River for the past several years declined in mature spruce but increased on the eastern side of the river. Only light to moderate defoliation occurred in the infestations along the Liard River. The total area of white and black spruces with light to moderate defoliation occurred on about 12 500 ha.

British Columbia

Increased populations in the Fort Nelson River valley near the Northwest Territories' border caused light defoliation of stands. In 1986 populations are expected to continue based on trends of previous outbreaks.

Western spruce budworms

Choristoneura spp. and *Acleris gloverana* (Wlshm.)

British Columbia

The area of mature and overmature Douglas-fir forests in the southwestern interior of British Columbia defoliated by the western spruce budworm, *Choristoneura occidentalis* Free., in 1985 increased more than threefold to 214 350 ha. A major expansion to 180 400 ha of mainly severe defoliation occurred in the Kamloops Lake–North Thompson River area in the Kamloops region. Light and moderate defoliation occurred for the first time since 1976 west of Lillooet and near Oliver in the Okanagan Valley. In the adjacent Cariboo region, the area of moderately or severely defoliated Douglas-fir increased 77% to 33 400 ha, mainly north and east of Clinton. Moderate defoliation of the current year's Douglas-fir foliage occurred over 50 ha near Rock Creek in the Nelson region, the 8th successive year of defoliation.

During 1981–85, the total area of Douglas-fir forests in the Thompson River drainage in the Kamloops region defoliated by *C. occidentalis*, defined by aerial and ground surveys, was about 185 000 ha — 58% was defoliated once, 23% twice, and 19% for 3-5yr. Mortality of understory regeneration was highly variable (0-95%) in stands near Clinton defoliated by the budworm for 4–7 consecutive years. Surviving trees had lost 2–4 yr height growth. Pheromone-baited traps were discontinued in 1985 but based on large moth flights and high numbers of eggs, defoliation of Douglas-fir stands is forecast to be moderate and severe in the Kamloops and Cariboo regions and light in the Nelson region.

One- and 2-yr-cycle budworms, *C. orae* Free. and *C. biennis* Free., lightly or moderately defoliated the current year's foliage of alpine fir and spruce over 6550 ha in eastern parts of the Cariboo and Prince George regions, compared with 12 700 ha in 1984. Endemic populations continued in an isolated pocket in the Nelson region, and populations remain low in previously active infestations in the Kispiox, Skeena, and Nass river drainages in the Prince Rupert region. Identification of these insects and their life cycles continues at the Biosystematics Research Institute, Ottawa. Defoliation is expected to be light to moderate, and more widespread, in the Cariboo and Prince George regions in 1986 when the predominantly 2-yr-cycle larvae mature.

In the 2nd yr of this outbreak, the western black-headed budworm, *Acleris gloverana* (Wlshm.), defoliated mostly old growth western hemlock and some amabilis fir and Douglas-fir over 45 600 ha in five forest regions, an increase from 19 000 ha in 1984. Mainly moderate defoliation covered 28 600 ha of mixed-age stands in numerous southeast coastal areas of the Queen Charlotte Islands, including parts of Lyell Island. Other defoliated areas included 2200 ha along mainland coastal inlets near Kitimat in the Prince Rupert region, 2150 ha west of Harrison Lake in the Vancouver region, 9400 ha in the interior wet belt near Quesnel in the Cariboo region, 3100 ha from Mabel Lake east of Vernon and north to Wells Gray Provincial Park in the Kamloops region, and 150 ha near Revelstoke in the Nelson region. Top-kill and tree mortality can usually be expected even after 1 yr of severe defoliation. After 2 yr of severe defoliation during the last outbreak in 1973-74 on the Queen Charlotte Islands, 67% of the immature and 33% of the mature trees in study plots were killed. Egg samples indicate increasing populations in 1986 and severe defoliation on the Queen Charlotte Islands, but low populations and trace or light defoliation in the Cariboo, Kamloops, Nelson, and Vancouver regions.

Jack pine budworm

Choristoneura pinus pinus Free.

This close relative of the spruce budworm has long been regarded a serious pest of jack pine stands and plantations in northwestern Ontario, Manitoba, Saskatchewan, and in the lake states of the USA. Only in recent years (1967-72) have destructive populations also occurred in central and eastern Ontario and Quebec. Tree mortality of up to 30-40% of the jack pine component in a stand may occur following 2-3 yr of moderate to severe defoliation. Top killing is common also and may result in half or more of the stand being damaged.

Ontario

Defoliation — In 1985 for the 3rd consecutive year, major increases occurred in the area affected by this insect. A total of 3.660 million ha of moderate to severe defoliation were mapped, an increase from 1.15 million ha in 1984. Defoliation occurred north of the 52nd parallel but survey maps were not available (Fig. 3).

The largest infestations occurred in the central part of the province in the northeastern and northern regions where a total area of 1.843 million ha had moderate to severe defoliation. Large parts of the Blind River, Espanola, Sudbury, Chapleau, Gogama, and Kirkland Lake districts were affected.

Infestations were nearly as widespread in the northwestern and north–central regions where 1.763 million ha were affected. The largest part of this was located along the Manitoba border in the Red Lake and Kenora districts, but sizeable infestations were also recorded in the Atikokan, Ignace, Dryden, and Fort Frances districts.

In the Algonquin region about 53 344 ha of moderate to severe defoliation were mapped along the northeast shore of Georgian Bay in the Parry Sound District.

Damage — Damage, in the form of whole tree mortality and top killing, is now becoming evident in areas infested since 1984 or earlier. Counts at about 14 locations in the Parry Sound District revealed an average of 24.6% whole tree mortality with an additional 37.3% top killing. In this area, many of the stands examined were on poor, rocky sites with shallow soils.

In northeastern Ontario, the highest damage levels were recorded in Monestime Township, Espanola District, where top killing of 41% and 33% was recorded at two locations with an additional 7% and 4% whole tree mortality. Low levels of top killing and tree mortality were also observed in several older infested areas in the remainder of northeastern Ontario.

In northwestern Ontario, in the southern Atikokan District, mortality in stands infested for 2 or more years ranged from 5 to 28% and top killing ranged from 1 to 27%, with an average of 14.2% tree mortality and 10% top killing. Light mortality and top killing were also recorded in the Red Lake District, the most severe of which occurred in Royd Lake where 3% mortality was recorded along with 33% top killing.

Control — To prevent severe defoliation and possible mortality in high-value stands, the Ontario Ministry of Natural Resources aerially sprayed about 221 000 ha of jack pine in several districts in the northern (Chapleau, Gogama, and Kirkland Lake districts) and northeastern (Blind River, Espanola, and Sudbury districts) regions. Two formulations (Dipel® 132 and Thuricide® 48 LV) of the biological insecticide *B.t.* were applied to target stands in late June and early July using both fixed-wing aircraft and helicopters.

Forecast — Egg sampling was carried out at 377 locations in 1985, 172 of which were also sampled in 1984. A comparison of locations sampled both years shows an overall decline of 59% in egg densities.

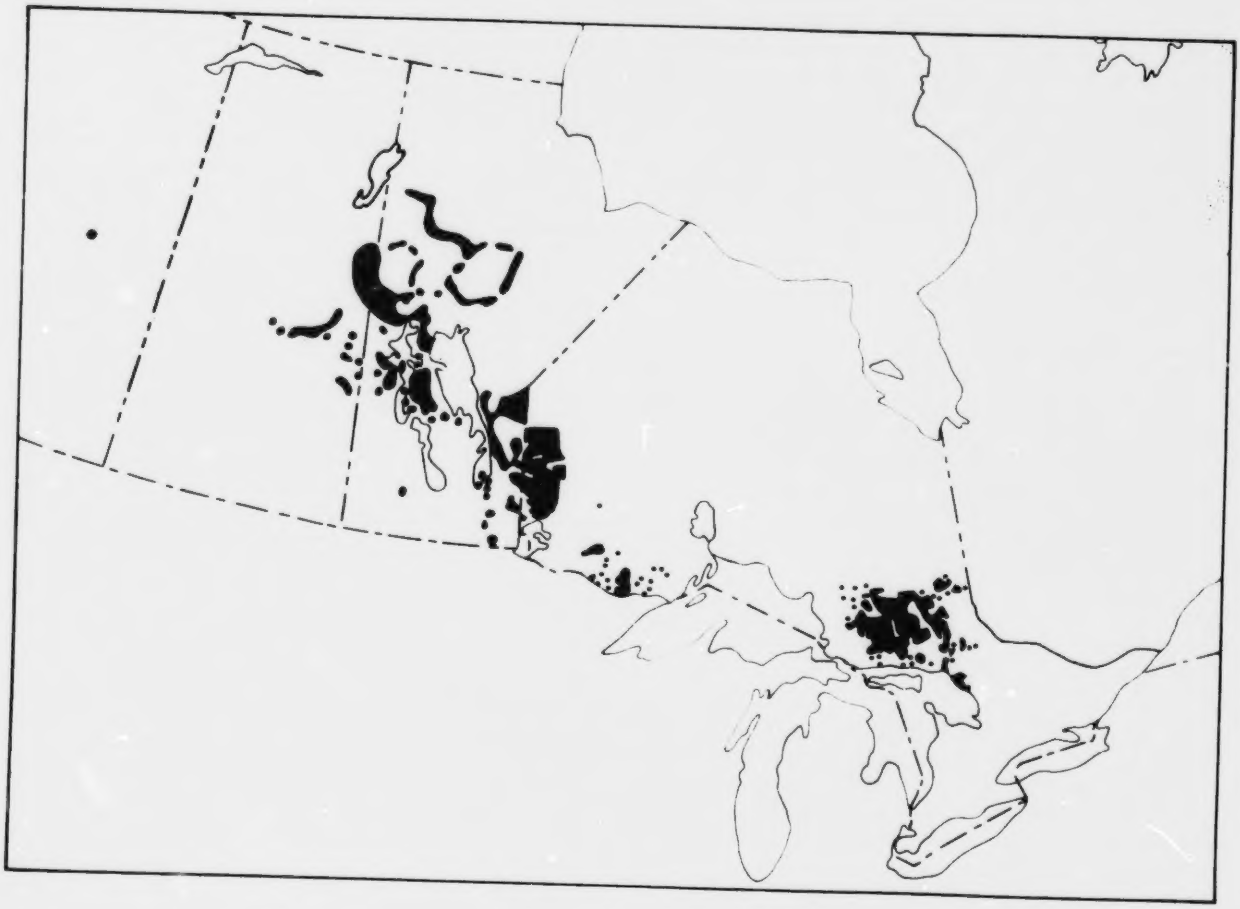

Figure 3. Areas of moderate to severe defoliation by the jack pine budworm.

In northwestern Ontario, despite a decline of about 61%, egg densities remain sufficiently high that moderate to severe defoliation is expected to persist within the 1985 infestation in the Kenora, Red Lake, Fort Frances, Ignace, and Dryden districts of the northwestern region and the Atikokan District of the north-central region. There is now a potential for the expansion and consolidation of these infestations into a single, huge area of moderate to severe defoliation from the northwest Atikokan District west through the Fort Frances, Ignace, and Kenora districts to the Manitoba border and north to the Trout Lake area of Red Lake District.

In the remainder of northwestern Ontario, mainly the southern Atikokan District and the southwest Thunder Bay District, infestations will probably decline although a few pockets of moderate to severe defoliation may persist in 1986.

In northeastern Ontario, populations will probably decline and may collapse over wide areas in the northern and northeastern regions and the Parry Sound District of the Algonquin region. Populations should remain moderately high in parts of Espanola, Sudbury, and Blind River districts, although the intensity of the damage and the area affected will be reduced from 1985 levels. Pockets of moderate to severe defoliation may persist in Chapleau and Gogama districts, while a sharp decline and possibly a complete collapse of populations is expected in the Kirkland Lake and Parry Sound districts.

Manitoba

The jack pine budworm infestation intensified and expanded in Manitoba. Moderate to severe defoliation of jack pine occurred within a total area of 2.048 million ha compared with 761 000 ha in

1984. The area defoliated in 1985 could be somewhat larger as defoliation became evident in some northern regions long after it was evident in the more southerly regions. A spray program was cancelled after a decline in populations of early budworm larvae within the proposed spray area.

Egg-mass surveys indicate a decline in budworm populations in some infested areas, but moderate to severe defoliation is expected in several of these areas in 1986.

Saskatchewan

There was a significant increase in the area within which moderate to severe defoliation of jack pine occurred, 130 000 ha compared with 27 000 ha in 1984. The largest area of continuous defoliation occurred near the Manitoba border.

Egg-mass counts indicate moderate to severe defoliation may recur in 1986 throughout the current infested areas.

Alberta

Jack pine budworm infestation is reported for the first time in Alberta. Light or moderate defoliation occurred on a few hectares of jack pine in three small areas in central Alberta. Light or moderate defoliation is expected to occur in these infested areas in 1986.

Mountain pine beetle

Dendroctonus ponderosae Hopk.

Lodgepole pine is the principal host of the mountain pine beetle, but several other western pine species are susceptible. The beetles attack trees in mid- to late summer and infect them with several microorganisms, including blue stain fungi. Eggs laid by female beetles yield larvae that feed on the inner bark. Infested trees generally die from the combined action of blue stain fungi and the beetle larvae. The foliage of killed trees usually turns brown in the year following attack and tree mortality can then be detected by aerial surveys.

Because most beetle-killed trees are of suitable size for saw logs, the monetary loss in commercial forests can be significant if trees are not salvaged quickly. Other consequences are a hastening of forest succession, a change in age and diameter distribution of the pine component of forests, a reduction in aesthetic values, and an increase in fire hazard. Each of these effects can force disruptive and costly changes in forest management plans. Poor lumber markets have greatly reduced the forest industry's ability to salvage recently killed trees, particularly in British Columbia where large volumes of dead trees are involved.

The mountain pine beetle continued to be the most damaging forest insect in Western Canada in 1985, resulting in extensive mortality of lodgepole pine and western white pine, mainly in British Columbia (Fig. 4), but also in Alberta and southwestern Saskatchewan. Further details on the status of the mountain pine beetle infestations follow.

British Columbia

Recent tree mortality caused by this most damaging pest in British Columbia covered over 300 000 ha, an area greater than that destroyed by forest fires in British Columbia in 1985. More than 9000 active infestations extending from the international border to north of Kitwanga contained about 6.5 million m^3 of mature lodgepole pine and some western white pine killed by 1984 beetle attacks. An additional 470 000 ha of forest in the Cariboo region was deleted from the inventory, because accumulated mortality before 1983 exceeds 30%, making it uneconomical to harvest. Infestations expanded slightly in the Kamloops and Prince George regions, declined in the Nelson and Prince Rupert regions, and were unchanged in the Vancouver region.

Despite significant brood mortality in October 1984 caused by sudden below normal temperatures, most infestations are expected to continue in 1986, but at greatly reduced levels particularly in the Cariboo region. Although standing green lodgepole pine attacked in 1985 and expected to die in 1986 averaged 17% (range 0-57%), about the same as in 1984, tree mortality will vary greatly among stands and regions.

Outbreaks in the Cariboo region affected 189 500 ha and contained 7.1 million pine trees (3.1 million m^3). This accounts for 65% of the total provincial area affected and represents about 7 times the average area logged of all species in the Cariboo region in 1983.

The area containing recent tree mortality in the Kamloops region increased 24% to 72 000 ha. About 1800 infestations contained 4.5 million trees (2.1 million m^3) in stands east and west of the Okanagan Valley and west of Lytton and Lillooet. In addition, about 80% of the trees on 25 000 ha within the infested area were killed in or before 1983.

In the Nelson region infestations covered about 13 850 ha and included 902 000 (326 000 m^3) lodgepole pine and some white pine in 1800 infestations.

Host depletion from previous beetle attacks and harvesting has limited expansion of infestations, particularly in the eastern part of the region. Infestations along the British Columbia–Alberta border and within Kootenay, Yoho, and Banff national parks declined.

The number, volume, and area of lodgepole pine killed in the Prince Rupert region declined 25% to 937 000 trees (910 000 m^3) on 11 000 ha. Harvesting and cut and burn programs contributed to the decline, caused mainly by a cool and wet 1984 summer that delayed brood establishment which contributed to poor overwintering brood survival. Major outbreaks continued in the Skeena River drainage between Hazelton and Terrace, in Harold Price Creek, and in the Nass, Cranberry, Kispiox, and Nilkitkwa river drainages.

In the Prince George region mortality of mature lodgepole pine and some western white pine declined to 1025 ha. The decline, largely due to host depletion, was significant in the Canoe Arm area south of Valemount, but infestations continued in the Fort St. James area and south of Vanderhoof near the Cariboo region border.

Tree mortality continued in 150 scattered infestations over 4200 ha in the Vancouver region, mostly in the Homathko River drainage just west of the extensive outbreaks in the Cariboo region. In the 4th yr of a control program, the number of beetle-killed trees in the eastern part of Manning Provincial Park increased to 250 in three areas, up slightly from 1984 but down from 5500 in 1981.

Depressed lumber markets continued to hamper salvage and control operations. However, in the

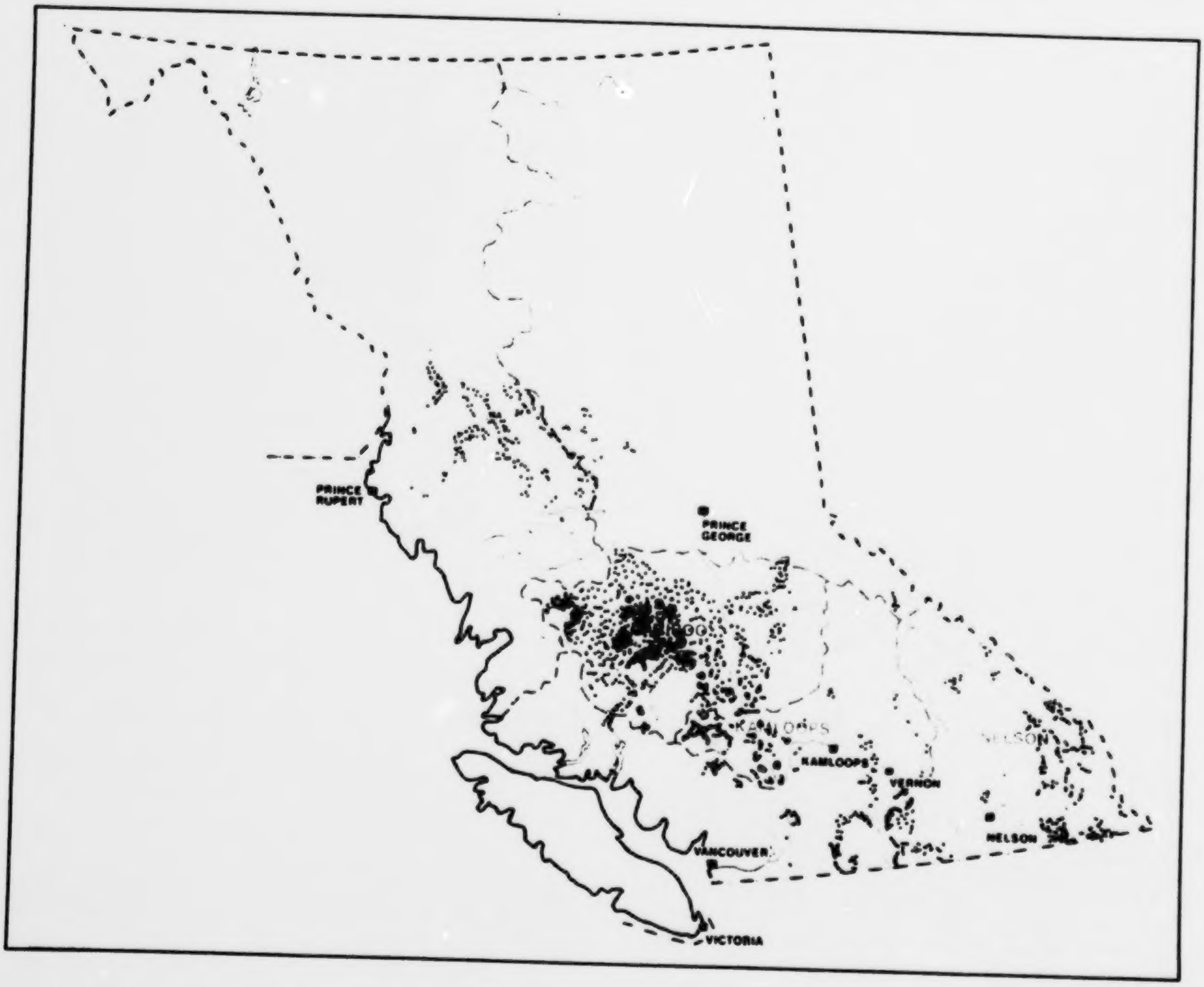

Figure 4. Areas of British Columbia in which mortality by the mountain pine beetle occurred.

2nd yr of a special protection program, the B.C. Ministry of Forests allocated $7 million towards road construction to extract threatened timber, cut and burn treatments to reduce the spread of the mountain pine beetle, aerial and ground surveys and pheromones for monitoring and restricting beetle dispersal.

Under the Canada/USA Memorandum of Understanding, mountain pine beetle program, there was an across-the-border review of the current status of infestations, beetle control, and stand management strategies including scheduled harvesting of high risk stands, small tree harvesting and utilization, pheromone trapping, and species conversion.

Alberta

Infestations of the mountain pine beetle continued to decline in all areas in 1985 except Kootenay National Park where they remained much the same as in 1984. No new infestations within the province were detected.

Based on aerial and ground surveys, the estimated tree mortality from 1984 attacks in the Bow-Crow Forest was 130 000 lodgepole pine (representing about 42 770 m^3) and 30 000 limber pine. Most lodgepole pine mortality occurred in the Pole Haven, an area directly east of Waterton Lakes National Park, while the limber pine mortality was scattered throughout the Porcupine Hills. About 100 new fader trees were reported throughout Cypress Hills Provincial Park and about 25 trees in the Kananaskis area. Estimates of 60, 50, 2000, and 100 new fader trees were made in Yoho, Banff, Kootenay, and Waterton Lakes national parks, respectively. No infestations were reported in Jasper National Park, but about 40, 1984-attacked and a similar number of 1985-attacked trees were identified several kilometres west in Mount Robson Provincial Park, B.C. Sanitation control of these trees is planned to reduce the risk of expansion and eastward spread of the beetle.

Control efforts of the mountain pine beetle were continued in the Bow-Crow Forest, Kananaskis area, and Cypress Hills Provincial Park, where 6500 infested lodgepole pine and 23 500 infested limber pine were cut and burned during the winter of 1984-85. Semiochemical tree baits were used throughout the control areas to assist in the detection and control of the beetle.

Saskatchewan

The numbers of lodgepole pine infested by the mountain pine beetle declined further in the Cypress Hills, for less than 50 new fader trees were reported in 1985. A control program maintained since 1980 was continued in 1985 and involved the removal of only 84 infested trees. This represents a major decline and is attributed to cold winter temperatures during 1983-84 and 1984-85, woodpecker predation, and the intensive control program. Semiochemical tree baits were also used for detection and beetle mop-up.

Spruce beetle

Dendroctonus rufipennis (Kby.)

One of the bark beetles that attacks living trees, this insect has become a problem where large amounts of logging slash, windthrow, or otherwise damaged trees allow population build-up. Mild winter conditions in Western Canada and spruce budworm defoliation in Eastern Canada have also been implicated in triggering outbreaks.

Attack by a large number of beetles can overwhelm even a healthy tree, disrupting conductive vessels as the beetles create their galleries under the bark. Not all attacks are successful because the tree tries to "pitch" the beetles out; however, enough successful attacks will lead to the death and sudden reddening of a tree within a year.

British Columbia

The affected area and volume of mature white and Engelmann spruce killed by 1983-84 beetle attacks declined threefold overall to 15 800 ha and 229 0000 m^3. This 3rd yr of decline was due mainly to salvage operations and host depletion, although in some areas early, below normal temperatures killed up to half the overwintering broods.

Although active in all regions, 46% of the affected area in the province was in the eastern part of the Prince Rupert region where 120 infestations over 7400 ha killed mature spruce (67 000 m^3) from the Kispiox River drainage south to Ootsa Lake. Beetle broods infesting scattered groups of two to five water-stressed, mature Sitka spruce over about 20 ha on the Queen Charlotte Islands remain a threat to adjacent trees.

Although surveys in three infested stands in the Prince Rupert region indicate a slight increase of new attacks to 14% of the standing mature trees, up from 8% in 1984, a general decline is expected to continue in this region in 1986. However, 2-yr-cycle populations that infested fresh, widespread windfall in 1984 in parts of north–central British Columbia, including the Prince Rupert region, could emerge in 1986 and attack standing mature spruce. Increased amounts of 1985 windthrow in some parts of the Prince George region could absorb some of the 1986 flight and contribute to population increases in 1987 and 1988.

Following a cooperative program of marking and treating brood-infested trees associated with the improvements on the Haines Road between the Yukon and Alaska borders in northwest British Columbia, no newly infested trees were observed in 1985, down from 300 in 1983.

Recent mortality of mature spruce in the Prince George region, mainly in the Bowron and McGregor river drainages, declined sixfold to 78 000 m^3 over 4000 ha. This represents about 6% of the total regional annual harvest. Rescheduling of harvest and salvage continues to be a priority. An additional 18 500 ha of previously beetle-killed spruce ("gray"), by now mostly unsalvageable, were mapped in the region.

Most infestations in other regions were associated with previously beetle-infested areas or recent logging activity. Infestations in the Cariboo region increased slightly to 2500 ha in scattered pockets in and near Bowron Lake Provincial Park. In the Nelson region, mortality of mature spruce declined to 570 ha in 45 areas in the Upper Arrow Lake and Upper Bull River drainages and near the southern boundary of Glacier National Park. In the Kamloops region, areas of recently killed spruce increased slightly to 1000 ha in 20 areas from east of Vernon to the Upper Adams River drainage and west of Lillooet.

Timely treatments of developing infestations have contributed to the overall decline, but relaxed utilization standards in some areas could contribute to population increases and tree mortality. Portions of the British Columbia Ministry of Forests special bark beetle fund started in 1984 and supplemented in 1985 have been allocated for ground surveys to locate sites for trap tree programs and to examine recent windthrow.

Alberta

Spruce beetle infestations remained low throughout Alberta in 1985. Several white spruce stands surveyed in the Peace River, Grande Prairie, and Footner Lake forests indicated that endemic populations were confined to a few small groups of standing trees, to single trees, and mostly to windthrown spruce. Several extensive overmature stands remain in northern forest districts and are susceptible to spruce beetle attack. However, salvage logging in 1984 and 1985 has helped to reduce the spruce beetle-caused losses and areas of susceptible forest. In the southern Bow-Crow Forest where 18 sites were monitored, the number of infested trees was less than 10% that recorded in 1984, indicating declining endemic populations.

Maritime Provinces

Spruce beetle attacks continued throughout the region in 1985, although the number of white spruce trees newly affected decreased compared with 1984 and especially 1983 when spruce beetle activity was very high. There were several locations in New Brunswick where infested trees were found for the first time in 1985.

In Nova Scotia, Cape Breton Island was the major outbreak area during the early 1980s and by the end of 1983 no large areas remained without severe white spruce mortality. Beetle activity subsided in 1984 and in 1985 a further reduction in newly attacked trees was observed, most mortality having occurred in Inverness and Victoria counties. However, more than half of the white spruce trees, especially the more mature ones, are now dead because of the outbreak in many areas. On the mainland, white spruce mortality was also much reduced from last year and was observed only in a few isolated pockets.

In Prince Edward Island spruce beetle activity occurred in Queens and Kings counties in previously affected areas but few newly attacked trees were observed. Because about a third of the province's merchantable white spruce succumbed to this insect in past years and many of the trees killed are in the hedgerows and windbreaks, the spruce beetle remains a serious threat to both forestry and agriculture.

In New Brunswick the small infestations reported in previous years remained active; however, except for the area in Fundy National Park, Albert County, activity was at a very low level for only a few white spruce trees were affected at most locations.

A special cooperative detection survey was undertaken in New Brunswick in 1985 by the Forest Insect and Disease Survey and the New Brunswick Department of Forests, Mines and Energy. The survey was prompted by the discovery of infested trees at widely separated areas of the province in previous years and by the concern over the damage potential of the insect as observed in the other Maritime provinces. A total of 68 locations were examined. These were selected on the basis of the inventory of mature white spruce and on suspicions of beetle activity. A minimum of 50 trees were assessed at each sampling point. Of the areas found to be infested only the central York County location was not previously known to harbor spruce beetle. Infestation levels were generally low. In northern New Brunswick the highest level of attack was 4% at Mount Carleton, Northumberland County. In southern New Brunswick 12% of the trees were recently infested in Fundy National Park, Albert County. At several locations only one successfully attacked tree was found in 1985. The current low level of infestation in most areas is less important than the fact that spruce beetle populations are present and could cause significant damage.

Newfoundland

Spruce beetle populations were at or near the endemic level in 1985. Few scattered, recently killed trees were seen in the Corner Brook area and no significant beetle activity occurred in other areas infested previously.

Eastern larch beetle

Dendroctonus simplex LeC.

This insect normally attacks only weakened, damaged, or recently felled host material. However, when populations are very high, the insect can also attack living, apparently healthy, mature or overmature trees. Even younger, small diameter trees can become infested.

Newfoundland

Eastern larch beetle infestations decreased again in 1985. Population levels are near endemic levels, except in a few stands south of Gander Lake where this beetle killed scattered groups of living larch trees.

Maritime Provinces

In the Maritimes, a population build-up was first noticed in Nova Scotia in 1976. This increase in beetle populations followed several years of severe larch defoliation by the larch sawfly, *Pristiphora erichsonii* (Htg.). Since then, the beetle has become widespread in all three provinces and has caused serious tree mortality. By the end of 1981, an estimated 24% of merchantable larch was dead in New Brunswick, 64% in Nova Scotia, and 13% in Prince Edward Island.

In 1985 the eastern larch beetle was common in northwestern and eastern New Brunswick and in western Nova Scotia, although a few newly infested trees were also found throughout much of the region. The downward trend in beetle activity observed in the last few years continued. This was confirmed by observations at the central New Brunswick research plot, where a further 2.8% of the trees became infested in 1985, compared with 3.8% in 1984.

Surveys indicate that the eastern larch beetle, unlike the spruce beetle, does not spread quickly once established, and that there is no definite pattern to its spread into new areas. Between 1979 and 1985 the beetle moved into 60% of uninfested areas in New Brunswick, 61% in Nova Scotia, and 20% in Prince Edward Island, based on reexamination of 99 sampling locations established in 1978.

The damage survey conducted in 1981 was repeated in 1985 and results show that there was an increase in tree mortality in New Brunswick (30% of merchantable larch dead from larch beetle attack) and in Prince Edward Island (23% mortality), while in Nova Scotia 49% of the larch volume is dead; the 15% decrease since 1981 is probably due to the disappearance of old dead trees from the stand.

Gypsy moth

Lymantria dispar (L.)

The gypsy moth has been the most destructive insect of hardwoods and to a lesser degree of conifers for decades in the northeastern United States. Female moths are flightless, limiting the spread of this pest to dispersal of the minute early instar larvae on air currents or to artificial transport as eggs or larvae on human conveyances.

Trapping male moths with pheromone traps has become a common practice throughout Canada. Trapping information is used to help detect the gypsy moth and define where local populations may be found and where to search for other life stages.

The gypsy moth was introduced into the United States around 1870. The first detection in Canada was in 1924 in southern Quebec and then in 1936 in southwestern New Brunswick. Both these infestations were successfully treated by the Plant Quarantine Division of Agriculture Canada. Since 1955, isolated infestations have been recorded in southern Quebec and up to 800 ha were treated annually from 1959 to 1965 to keep the infestations under control. However, during 1966–67 the infested area increased rapidly and became widespread. In 1969–70 the insect moved into eastern Ontario and in the following years, small pockets of infestation were observed at various locations in the eastern region, particularly in the Cornwall and Kingston areas. From 1975 to 1980, the northward movement of the insect was slowed by the treatment of critical areas. From 1980 to 1985, however, the general area of infestation expanded considerably. The gypsy moth reappeared in the Maritimes in 1981 and by 1983 was considered to be at least temporarily established in both New Brunswick and Nova Scotia.

The gypsy moth was first found in Vancouver, B.C., in 1978 and a control program was carried out by the Plant Health Division of Agriculture Canada and the city of Vancouver in 1979 to eradicate it.

Newfoundland

A survey was again conducted in 1985 in cooperation with the Plant Health Division of Agriculture Canada to monitor any accidental introduction of this pest to the province. Pheromone traps placed in camping parks and near major towns trapped only one male moth in Mummichog Provincial Park in western Newfoundland, the second record of this species on the island. Capture of a male moth does not necessarily indicate an established population.

Maritime Provinces

After its reappearance in the Maritimes in 1981, the gypsy moth spread in 1985 and is now at least temporarily established in both New Brunswick and Nova Scotia. It has been the most destructive insect of hardwoods and to a lesser degree of conifers in the northeastern United States for decades. The status of the outbreak in Maine in the last few years has concerned the Maritimes because of its proximity to that region.

The gypsy moth monitoring committee remained active in 1985 and again coordinated all surveys. This committee was formed in response to the discovery of gypsy moth in 1981 to use available manpower more efficiently in combatting this latest threat to the region's forests. Organizations involved in surveys include the Forest Insect and Disease Survey of the Canadian Forestry Service; Parks Canada of the federal Department of Environment; the Plant Health and Inspection Branch of Agriculture Canada; New Brunswick Department of Forests, Mines and Energy, New Brunswick Department of Agriculture; Nova Scotia Department of Lands and Forests, Nova Scotia Department of Agriculture; and Prince Edward Island Department of Energy and Forestry. Also, many volunteers, campground operators, small woodlot owners, biology teachers, students, and other interested private citizens assisted in the pheromone trapping program.

In 1985, early season egg-mass surveys, larval surveys, adult trapping program, and late fall egg-mass surveys were conducted to determine the current status of the insect in the region. The adult male trapping program aims to define areas where searching for egg masses should be concentrated. As a result of studies since 1980, the trap placement design was changed in 1983 to eliminate, or at least to minimize, interference from large numbers of male moths (females are flightless) brought into the region by weather fronts from infested areas in the United States. Information was obtained from 1964 traps: 945 in New Brunswick, 824 in Nova Scotia, and 195 in Prince Edward Island. Better understanding by cooperators of the value of negative results greatly aided the planning of the fall egg-mass surveys.

The status of the gypsy moth in the Maritimes follows. In New Brunswick, gypsy moth was found at 11 locations in southwestern Charlotte County and, contiguous to this area, at Forest City and at St. Croix in the extreme southwestern part of York County. There are now 21 locations in this part of the province where some life stages of the insect have been found since 1981 and this area must be considered infested. Generally, the population levels were low and the insect (larvae, pupae, egg masses) was found only because of diligent searching. However, more than 70 egg masses were found on a single oak tree in St. Stephen and the timely application of control measures prevented serious defoliation. Elsewhere in the province the low level infestation continued in Fredericton and a single larva was found near Peel, Carleton County. This latter location represents a considerable extension in range, but the significance of the find is undetermined as no egg masses were recovered during fall surveys.

In Nova Scotia, the gypsy moth has been found in at least one location in eight of the nine counties in the western half of the province. The insect has not been found yet in Queens County or east of the Windsor-Dartmouth line. Most of the infested areas were in the Annapolis Valley. The highest populations in 1985 occurred at New Minas, Kings County, where more than 100 egg masses were counted on a single apple tree in the late summer, and in the town of Shelburne where larvae, and later egg masses, were numerous.

In Prince Edward Island the gypsy moth is not yet known to occur.

In New Brunswick most of the gypsy moth locations are in forested areas away from habitation and are concentrated in a small section of the province adjacent to an area of the United States where the insect is known to be present. In Nova Scotia almost all the infested spots are inhabited areas with considerable movement of people. This suggests that while in New Brunswick the presence of gypsy moth, in most places, may be the result of natural spread, in Nova Scotia the insect was likely imported by tourists or residents travelling in gypsy moth infested areas.

Control operations against the gypsy moth in 1985 were localized and sporadic and no reliable information is available. Several communities became involved in public awareness programs emphasizing citizen participation in combatting this newly arrived pest.

Quebec

Gypsy moth populations increased slightly in 1985. New infested areas appeared in many locations within the general area where the insect's presence is already documented, particularly in Granby, Chambly, La Prairie, St-Antoine-Abbé, and Rigaud. In all these cases, defoliation did not exceed the moderate level, affecting small areas of 2–3 ha (although sometimes larger areas were involved, including 20 ha at La Prairie along Hwy 104); the most severely affected species were trembling aspen, grey birch, and red oak. East of the St-François River, moderate defoliation of red maple was observed 5 km west of La Visitation (Yamaska).

Significant defoliation occurred for the first time north of the Ottawa River, near Hwy 148 between Thurso and Calumet. Although adult males have been trapped in this area since 1976, no damage had been observed previously. This year, a total of 182 ha of red oak and bur oak (90%), largetooth aspen (6%), eastern white pine (3%), white birch and white spruce (1%) suffered severe (40 ha), moderate (134 ha), or light (8 ha) defoliation. The main infested areas were between Thurso and Montebello, Pointe-au-Chêne and Calumet, and 2 km north of Chelsea on Hwy 105.

On the north shore of the St. Lawrence River, two small pockets (about 2 ha) of moderate to severe defoliation were observed: one near Mascouche along Hwy 640, and the other north of Hwy 40 opposite Lanoraie. The known area of severe defoliation near St-Louis-de-France, north of Cap-de-la-Madeleine, remains significant this year, but populations are suffering the effects of a viral disease. In all cases, affected species have been oak, poplar, birch, and speckled alder (Ste-Julie-de-Verchères).

The Laurentian Forestry Centre (LFC), in cooperation with the Plant Protection Division of Agriculture Canada, again installed 250 pheromone traps this year in south–central Quebec to obtain annual data on the movements of male moths. Results show a significant increase in catches: 6448 moths were trapped in 1985 at an average of 26.6 per trap, compared with 19.4 per trap in 1984; this represents a 37% increase. The largest increases were recorded east of the St-François and St-Maurice rivers, where the gypsy moth is becoming progressively more established. The Quebec Department of Energy and Resources surveyed egg masses in the areas most defoliated in 1985; results indicate that the level of damage will be maintained or will continue to rise in 1986.

An egg-mass search was also conducted by the LFC, in cooperation with the Plant Protection Divison of Agriculture Canada, in the Chaudière River valley as far as the Maine (USA) border. A few masses were found for the first time near the following locations: St-Victor, St-Éphrem-de-Beauce, and St-Prosper (Beauce); Ste-Hénédine and St-Édouard-de-Frampton (Dorchester); and St-Gervais (Bellechasse). This tends to confirm a significant extension of the insect's distribution zone in this area.

Ontario

The area sustaining moderate to severe defoliation by this insect more than tripled in 1985 to 246 342 ha. Most of the damage was again located in the eastern region, mainly in the Tweed and Napanee districts, with several extensions in the Brockville and Carleton Place districts (Fig. 5). For the first time, moderate to severe gypsy moth defoliation was mapped in the southern Algonquin region when several small pockets totalling about 90 ha were mapped in Lyndoch, Griffith, Brougham, and Blithfield townships, Pembroke District. In addition, about 240 ha of moderate to severe defoliation was found southwest of Oak Lake in Methuen Township, Bancroft District. A small part of this infestation intruded into Belmont Township, Lindsay District, in the central region. Small areas of light infestation were recorded near Port Colbourne in the Niagara District where egg-laying female moths were discovered in the fall of 1984.

The Ontario FIDS unit again carried out a cooperative larval trapping program with the parks branch of the Ontario Ministry of Natural Resources (OMNR) in the southern part of the province. Burlap traps were installed at 67 locations, mainly provincial parks, and monitored daily by OMNR staff. Suspect larvae were identified at the Sault laboratory. The program yielded positive results at 17 locations in the eastern region within the area considered to be generally infested. However, larval catches at Bonnechere Provincial Park in the Pembroke District and Turkey Point Provincial Park in the Simcoe District were more significant as this is the first time that the program has yielded results outside the generally infested area in the eastern region.

Adult pheromone trapping was carried out at the same parks in southern Ontario where the larval trapping took place. Adult male moths were captured at 51 of 67 parks compared with 49 of 64 in 1984. As expected, the highest numbers of moths

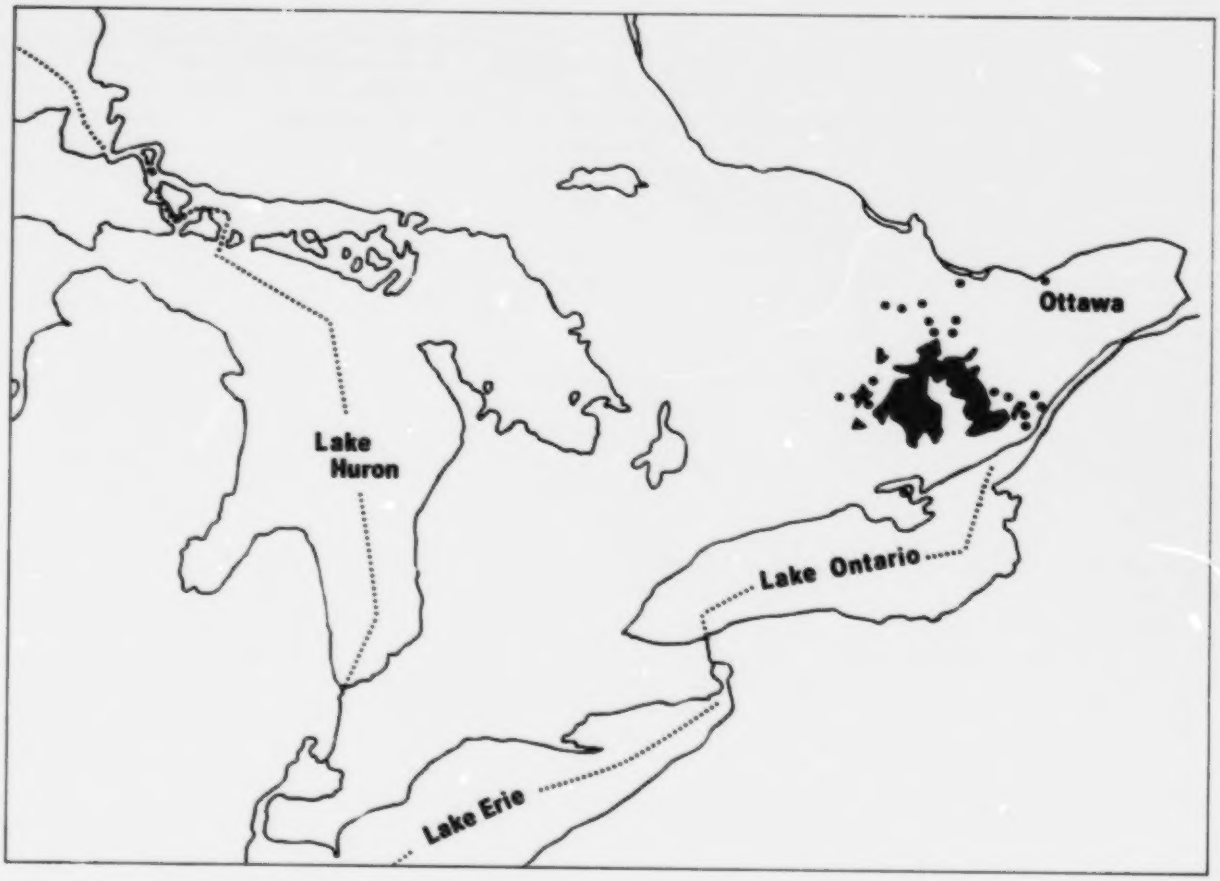

Figure 5. Areas of moderate to severe defoliation by the gypsy moth in eastern Ontario.

were captured in the eastern region, but numerous catches were also made in the Algonquin, central, and southwestern regions. In addition, large numbers of moths were captured at Canadian Forces Base Petawawa, in the Pembroke District where a high potential for spread exists due to the constant movement of personnel and equipment to other parts of the country.

As usual, a separate pheromone trapping program was carried out in northern Ontario parks and campgrounds. Traps were placed in 51 parks and campgrounds with negative results at all but five. These were located as follows: Agawa Bay Campground in Lake Superior Provincial Park, Wawa District; Mississagi Provincial Park, Blind River District; Antoine Provincial Park, North Bay District; and South Bay Resort and Red Lodge on Manitoulin Island, Espanola District. The captures at Red Lodge represent the 2nd consecutive year that adult moths have been recovered at this location. No adults were captured at three other locations in northern Ontario where moths were trapped in 1984 despite using additional traps.

To prevent mortality and preserve aesthetic values, OMNR sprayed a total area of about 170 ha in Frontenac, Sharbot Lake, and Silver Lake provincial parks with *Bacillus thuringiensis* (*B.t.*). Although some applications had to be repeated, control was generally good.

In the fall of 1985, OMNR staff, with technical assistance from FIDS, completed the largest gypsy moth egg survey ever conducted in Ontario. The survey focussed on the eastern region and adjacent areas of the Algonquin and central regions. The data collected during the survey was used to formulate plans for a control program in 1986 and indicated that about 750 000 ha of defoliation may occur in 1986.

British Columbia

First recorded in the lower mainland of British Columbia in 1978, the discovery of small numbers of moths, egg masses, and larvae in 1983 and 1984 resulted in small designated areas of Courtenay and Chilliwack being sprayed with *B.t.* in 1985. Subsequently, 14 male moths were trapped at Chilliwack near the Canadian Forces base, 1 at Cultus Lake, 1 near Abbotsford, and 1 about 4 km north of Cache Creek. None were trapped at 142 forest recreation areas monitored by the Forest Insect and Disease Survey or in nearly 6000 traps placed elsewhere throughout the province in cooperation with Agriculture Canada (Plant Health) and the B.C. Ministry of Forests. Defoliation has not occurred and populations have not yet become established in British Columbia.

Although shade trees, most hardwoods, and possibly young conifers could be defoliated if populations become established, the major forestry concern would likely be quarantine restrictions, such as those implemented in active gypsy moth areas in Oregon. Trapping programs and, if necessary, egg-mass surveys are planned in 1986.

Forest tent caterpillar

Malacosoma disstria Hbn.

The forest tent caterpillar again caused moderate to severe defoliation on trembling aspen, as well as a variety of other hosts in many areas of Canada (Fig. 6). Although outbreaks of this insect can be spectacular in appearance, there have been few

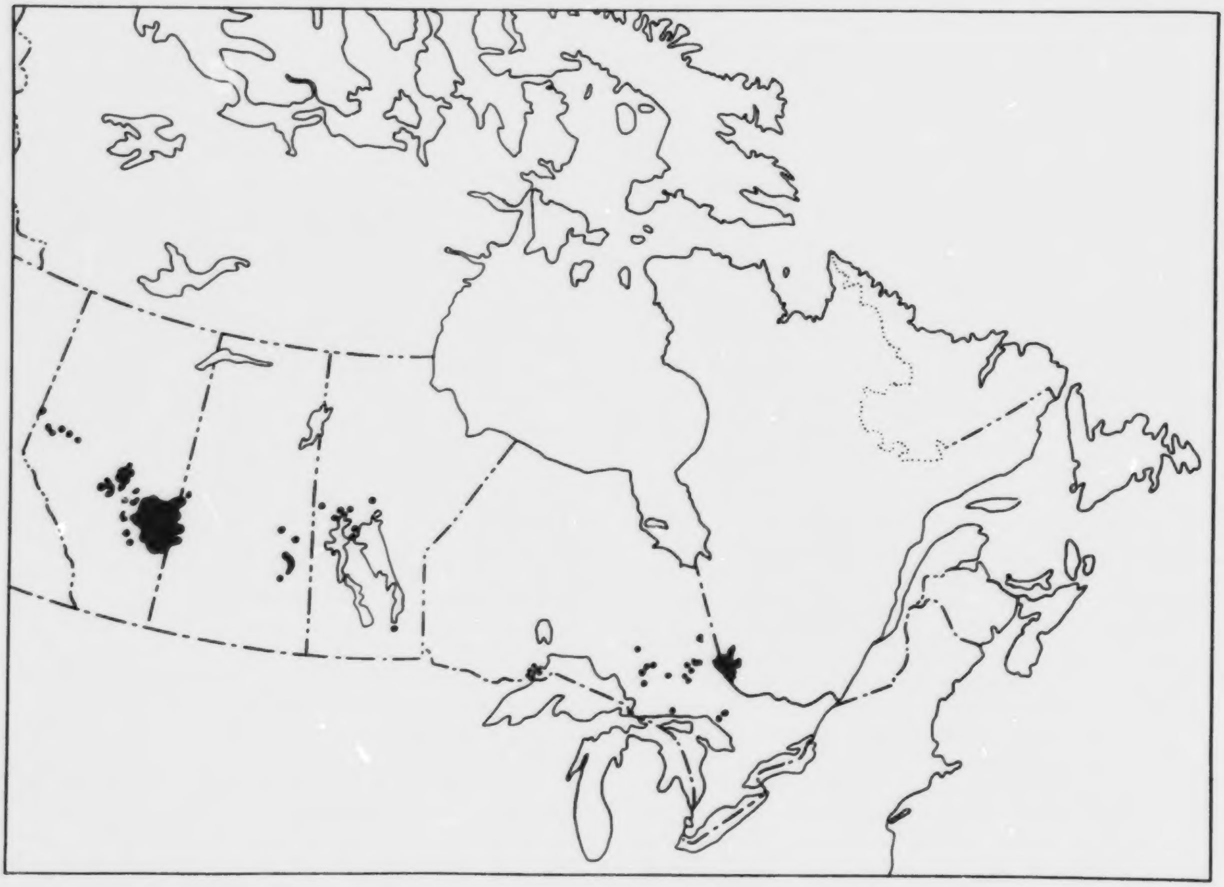

Figure 6. Areas of moderate to severe defoliation by the forest tent caterpillar.

reports of appreciable tree mortality. The main effect of outbreaks has been the reduction in annual growth of severely defoliated trees. The significance of this reduction is difficult to assess. The affected tree species constitute a major portion of the hardwood volume in Canada, yet a relatively small portion of it is harvested each year. As the utilization and management of aspen intensify, the impact of aspen defoliators will become more significant.

Newfoundland

Pheromone traps were located in camping grounds and near towns along the west coast and other major towns throughout the island. A total of three male moths were trapped in Gros Morne National Park.

Maritime Provinces

The forest tent caterpillar, the major defoliator of hardwoods in the Maritimes since the late 1970s, has declined in the past few years. In 1985 the outbreak ended in New Brunswick (the first time no noticeable defoliation occurred since 1978) and Prince Edward Island. The area of moderate or severe defoliation was drastically reduced in Nova Scotia.

The insect feeds on a wide variety of hardwood trees, preferring trembling aspen, oak, apple, birch, and cherry. When populations are high and larvae migrate in search of food, other tree species such as sugar maple, ash, alder, elm, and ground vegetation are also readily defoliated. Feeding also occurs on some conifers, notably larch and white spruce.

The outbreak has been shifting to the southeast since it first started in the Woodstock, Carleton County, area in 1979. There has been a build-up of disease, parasites, and predators such as the large flesh fly; there was mass starvation of larvae at the height of the outbreak at many locations resulting in fewer egg masses laid. These are factors in weakening the forest tent caterpillar population. In addition, there were 2 consecutive years when the early summer was cool and precipitation was much above normal. A weakened forest tent caterpillar population combined with weather conditions unfavorable to its survival hastened the collapse of the New Brunswick outbreak.

In Nova Scotia a total of 21 600 ha of defoliation occurred which was mostly light, with patches of moderate or severe defoliation in parts of Hants, Kings, and Annapolis counties.

In Prince Edward Island the outbreak that persisted in Prince County since 1973 collapsed in 1985.

Fall egg-mass surveys and the results of the pheromone trapping program conducted during the moth flight period in the summer of 1985 both indicate that forest tent caterpillar populations will be generally low in 1986.

Repeated severe defoliation results in twig and branch mortality. A survey was conducted to assess the condition of trembling aspen in the region in 1985 in the aftermath of the current outbreak. The results show that less than 60% of the trembling aspen was classified as healthy in any of the three provinces and that stands with the highest degree of deterioration were generally in areas with the greatest number of successive years of severe defoliation by the forest tent caterpillar or other insects.

Quebec

After a 10-yr absence from the Témiscamingue area, this insect made a strong and spectacular comeback by infesting about 2000 km^2 of forest; the epicentre of this infestation is in St-Bruno-de-Guigues. Severe damage occurred along hwys 101, 391, and 382 northward as far as Rollet, westward to Lake Témiscamingue, south as far as Laniel, and east as far as Laforce. Along these roads, trembling aspen in particular suffered complete defoliation over 870 ha and pockets of moderate and light defoliation were also found over 31 and 56 ha, respectively. Where defoliation was most severe, white birch, speckled alder, balsam poplar, and largetooth aspen suffered complete or partial defoliation. The locations most affected were St-Bruno-de-Guigues, Ville-Marie, Angliers, Fugèreville, Latulipe and Moffet. This infestation complements that observed in recent years in Ontario, west of Lake Témiscamingue in the adjacent districts of Kirkland Lake and Temagami.

An egg-mass survey was conducted in 35 stations located in and around the affected area. Populations are expected to continue to be high where significant defoliation was reported in 1985, and population expansion may occur north of the municipality of Rollet. Several insect colonies were found north of Lake Duparquet on Hwy 388 and several kilometres north of Palmarolle.

Ontario

The area of moderate to severe defoliation by this insect increased in Ontario for the 2nd consecutive year. Altogether, 208 942 ha of moderate to severe damage were mapped in the province in 1985 compared with 124 750 ha in 1984. The infestations were located in the north-central, northern, northeastern, and Algonquin regions.

In the north-central region, an 8-yr-old infestation located near the city of Thunder Bay declined from 38 500 ha of moderate to severe defoliation in 1984 to 5000 ha in 1985. The infestation broke up into several scattered pockets located south of the city, in Blake and Crooks townships, Indian Reserve 52, and on Pie Island at the entrance to Thunder Bay on Lake Superior. Egg-band counts made in the fall of 1985 indicate that this infestation will probably continue to decline in 1986.

Infestations in the northern region were located mainly in the Kirkland Lake District along with several small pockets in the Chapleau and Gogama districts. The largest infestation encompassed about 157 178 ha west of Lake Timiskaming extending south into the northeast corner of the Temagami District of the northeastern region. Egg-band counts indicate that this infestation will remain heavy in 1986 and will probably expand slightly. The second largest infestation encompassing 16 368 ha of moderate to severe defoliation occurred west of the town of Gowganda in the southwest Kirkland Lake District. Egg-band counts indicate that this infestation will probably expand considerably in 1986, possibly merging with pockets of moderate to severe defoliation which were mapped in nearby Churchill and Macmurchy townships of the Gogama District. A third infestation was located in the northwest corner of the Kirkland Lake District near Painkiller Lake. About 11 800 ha of trembling aspen stands were moderately to severely defoliated, an increase of about 5200 ha over the area affected in 1984. This included about 1200 ha in adjacent Wilkie Township of the Cochrane District. This infestation will probably persist at about the same size and defoliation intensity in 1986.

In the northeastern region, a new infestation of about 13 000 ha was detected by aerial surveys in Nebotik and Conking townships in the Wawa District. This infestation was inaccessible, however, preventing confirmation by ground checks and egg-band counts. A small infestation south of Elliot Lake in Proctor Township, Blind River District, declined from 1200 to 300 ha in 1985. Egg-band counts indicate, however, that this infestation will expand again in 1986.

Two new infestations were located in the Algonquin region, in Burton and McKenzie townships, Parry Sound District, where a total of about 1000 ha of trembling aspen and red oak were moderately to severely defoliated. A limited number of egg-band samples indicate that these infestations will probably expand in 1986. The potential for infestation also exists in several other areas in the province where increased numbers of colonies and wandering larvae were observed in 1985.

Manitoba

In Manitoba the area within which moderate to severe defoliation of trembling aspen occurred declined from about 600 000 ha in 1984 to 14 000 ha in 1985. Egg-band surveys indicate that the forest tent caterpillar infestations will continue to decline in 1986.

Saskatchewan

In eastern and western Saskatchewan, the areas within which moderate to severe defoliation of trembling aspen occurred increased to 31 000 ha in 1985. Egg-band counts indicate that light to moderate defoliation with pockets of moderate to severe defoliation by the forest tent caterpillar may occur within these areas in 1986.

Alberta

Infestations by the forest tent caterpillar increased and moderate to severe defoliation occurred on aspen stands scattered within a total area of about 2 000 000 ha (containing 70 000 ha of aspen). The largest area is in east-central Alberta and there are smaller patches of infestations in the north and northwest. Egg-band surveys indicate that the infestations may expand slightly in 1986.

British Columbia

About 59 000 ha of trembling aspen and some balsam poplar stands in northern British Columbia were defoliated by forest tent caterpillar. For the 3rd yr, moderate or severe defoliation occurred along the Peace River. Populations in the Salmon River Valley north of Prince George, however, collapsed due to natural control factors. In the Prince Rupert region stands totalling 900 ha from Moricetown to Kitwanga were again defoliated. Scattered aspen and cottonwood groves and other trees and shrubs over about 125 ha were moderately or severely defoliated around Trail and Warfield in the Nelson region.

Egg surveys in the Peace River area and Prince Rupert region indicate moderate to severe defoliation is expected to occur in 1986.

Hemlock looper

Lambdina fiscellaria fiscellaria (Gn.)

The hemlock looper is native to Canada and occurs from Newfoundland to Alberta, mainly on balsam fir. In the East its main host is balsam fir and in the West it is hemlock. During an outbreak, however, it will feed on many conifers and even some hardwoods. Although all eastern provinces have periodic outbreaks, Newfoundland has regular epidemics lasting from 3 to 6 yr and occurring every 10–15 yr.

Newfoundland

Defoliation — The increase in infestation levels during the last few years continued in 1985 with a slight increase over 1984 levels, although this was less than the forecast amounts (Fig. 7).

The area of moderate and severe defoliation forecast for 1985 on the island was about 273 000 ha with an additonal 437 000 ha in the light category. Larval surveys conducted during the summer showed a decrease in looper population levels in central Newfoundland and on the Avalon Peninsula. The reasons for this decrease include relatively poor larval development in immature balsam fir and black spruce stands, especially in central Newfoundland, and the occurrence of fungal disease in the older parts of the outbreak. In addition, there was a poor correlation between looper numbers and subsequent defoliation. The area of severe defoliation was also reduced by the application of insecticides by the Department of Forest Resources and Lands. The aerial survey conducted in September recorded about 51 800 ha of moderate and severe defoliation on the island distributed mainly in mature forests in the upper river valley in western Newfoundland and in several widely separated areas in central and eastern Newfoundland. Light defoliation occurred on about 79 000 ha distributed mostly in isolated areas throughout the island.

Control — The Department of Forest Resources and Lands conducted an operational control program in July against the hemlock looper, treating about 136 330 ha with fenitrothion and 2365 ha with *Bacillus thuringiensis* (*B.t.*).

The Canadian Forestry Service in cooperation with the Department of Forest Resources and Lands conducted an experimental program testing the effectiveness of Matacil®, fenitrothion, *B.t.*, and Dimilin® against the looper.

The assessment of the biological mortality factors was concentrated in the older part of the outbreak near Bay d'Espoir and on the Avalon Peninsula. Less than 1% of the larval samples were parasitized; the parasites recovered were 37% braconids, 38% ichneumonids, and 25% of parasite larvae died before cocooning. Of the pupal parasites recovered, 7% were ichneumonids, 43% chalcids, and 50% tachinids. About 4% of the larval samples were infected by a fungus, *Entomophaga aulicae*. Most of the infection was detected in samples collected during late July when the larvae were mainly in the fourth instar. About 21% of the pupal samples were also killed by the fungus *E. aulicae*.

Damage — No significant tree mortality was caused by the looper until 1985, the 3rd yr of the outbreak. Tree mortality became evident in 1985 in the older part of the outbreak near Twin Lakes, Bay d'Espoir, and Lake St. John in central Newfoundland, and near Long Harbour on the Avalon Peninsula. The proportion of tree mortality varied from 2 to 10% in these areas. The Department of Forest Resources and Lands will assess the volume of damage at the inventory level.

Forecast — The egg survey was delayed because moth emergence, mating, and oviposition continued until late October. One mid-crown branch from each of five trees was collected in each of 668 sample points throughout the island. Based on these egg counts and the distribution of larval populations in 1985, moderate and severe defoliation is forecast to occur on about 219 000 ha in 1986 distributed in four major areas in western Newfoundland and in several smaller areas in central and eastern Newfoundland. Light defoliation is expected to occur on about 693 000 ha throughout the island. The egg density was very low (one egg per branch sample) in about 164 700 ha of this forecast category and defoliation may not become evident in these areas.

Maritime Provinces

Hemlock looper, contrary to its name, is a defoliator mainly of balsam fir in the Maritimes, capable of causing serious damage at high populations. In addition to feeding on needles of any age, the insect is a wasteful and messy eater. Larvae remove but do not consume the entire needle; consequently, a much greater amount of foliage is removed than necessary for larval development.

In the Maritimes, populations have been generally low in the past few years. The last serious outbreak occurred in central Prince Edward Island in 1977–78 when the insect killed 80% of the merchantable balsam fir and over 90% of the hemlock in the affected area.

In 1985 hemlock looper and spruce budworm caused up to 50% total defoliation in a white spruce–balsam fir stand over 16 ha at Diligent

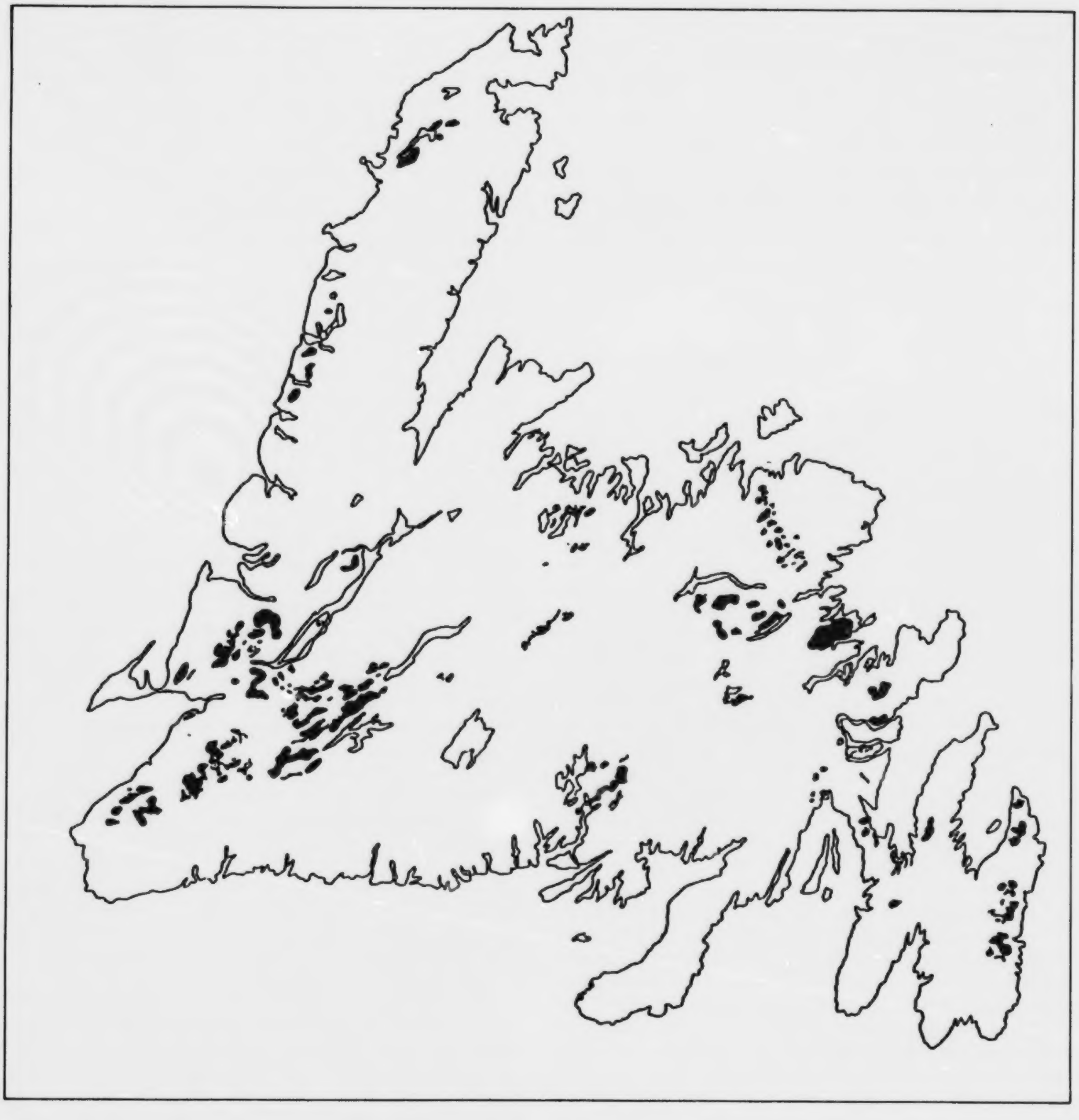

Figure 7. Areas of moderate to severe defoliation by the hemlock looper in Newfoundland.

River, Cumberland County, Nova Scotia, the hemlock looper evident on older foliage of the balsam fir component. Moths were observed in the early fall at Outer Island, Shelburne County; the populations were low in the rest of the province.

In Prince Edward Island hemlock looper caused patchy, but in places severe, loss of old and new needles over a 2000-ha area near Cross River, Kings County.

In New Brunswick a few larvae were collected at scattered locations but hemlock looper populations were low.

Dutch elm disease

Ceratocystis ulmi (Buis.) C. Moreau

Dutch elm disease is caused by the fungus *Ceratocystis ulmi*, which is transmitted chiefly by elm bark beetles. It was accidentally introduced into Canada and since its first discovery in Quebec has spread over an area stretching from southern Manitoba to the Atlantic Ocean, excluding Newfoundland. All native species of elm are susceptible, including white, red, and rock elms. The disease has caused extensive mortality in eastern North America and will probably become a serious problem in all areas where elms are grown. Few, if any, pests have had as great an impact on shade tree populations in urban areas as has Dutch elm disease. Elms are also valuable timber producing species in some areas and there the disease has had an important effect on the local economy.

In 1982 *Forest Insect and Disease Conditions in Canada* reviewed the history and status of Dutch elm disease. An update follows.

Maritime Provinces

Dutch elm disease was a major concern in all three Maritime provinces in 1985.

In New Brunswick, where the disease is present wherever elm trees are found, the resurgence of infection reported in 1984 continued. Numerous infected and dying trees, both residual old trees and young saplings, were observed throughout the province in 1985.

In Nova Scotia there were 19 locations where Dutch elm disease was found for the first time in 1985, although many of these were within previously infected areas. Significant extension occurred in the range of the disease on Cape Breton Island and there was considerable "filling in" on the mainland. The intensification of the disease within outbreak areas where no sanitation is practiced was evidenced by the presence of numerous newly infected trees. On the permanent assessment plot near Newport, Hants County, where 11% of the trees became infected between 1980 and 1982 the infection rate increased to 55% in 1983, 69% in 1984, and 74% in 1985. This pattern agrees closely with that found in other parts of the Maritimes and indicates that most elm trees will become infected within a few years in this area.

In Prince Edward Island an infected elm tree was found near Portage, Prince County, in 1985 in essentially the same, and only, area where the disease occurred previously. The infected tree was removed and destroyed. The disease was first discovered in the province in 1979. This discovery was followed by an immediate, vigorous sanitation cut by the provincial government. No infected trees were found in 1980 and 1981, one infected tree was identified and removed in 1982, and there were none found in 1983 or 1984.

In Fredericton the progress of Dutch elm disease and the effect of the control program have been monitored since 1961 when the disease was first found in the city. The 41 trees killed by the disease in 1985 represented 1.2% of the current elm population within the Dutch elm disease management area. This loss conforms with the reduction of the loss rate since 1980 when it peaked at 7.8% followed by 5.3% in 1981, 3.0% in 1982, 2.4% in 1983, and 1.1% in 1984. Losses to date amount to 17.8% of the original urban elm stand.

No systematic survey was conducted by the Forest Insect and Disease Survey in 1985 for elm bark beetles, the carriers of Dutch elm disease, except in Fredericton, where populations of the native elm bark beetle, *Hylurgopinus rufipes* (Eichh.) remained low.

Manitoba

In Manitoba, Dutch elm disease continued to increase in wild elm stands, but diseased elms in urban centers with control programs were comparably low. Less than 1% of Winnipeg's elms were diseased, and in Brandon less than 2%. Most of these trees are found in wild stands along riverbanks where control measures are less effective.

Saskatchewan and Alberta

In Saskatchewan intensive surveys did not detect any diseased trees in 1985. Endemic populations of the native elm bark beetles were found in native elm areas in the province.

No evidence of the native elm bark beetle or Dutch elm disease was found in Alberta.

Scleroderris canker

Gremmeniella abietina (Lagerb.) Morelet

Scleroderris canker has been detected in all provinces except Prince Edward Island, Manitoba, and Saskatchewan. This disease of conifers is caused by the fungus *Gremmeniella abietina*. At least two races of this fungus (North American and European) have been determined serologically.

NORTH AMERICAN RACE

The North American race of *G. abietina* is widely distributed in Canada and has been a serious problem in nurseries and young plantations for many years. Extensive studies of the disease have provided several control recommendations. In Eastern Canada the disease is most damaging to pines, especially red, jack, and Scots pines, and often kills them during their first decade of growth. Once the trees are about 2 m high, they are relatively safe from lethal attack. In Western Canada, where lodgepole, ponderosa, and whitebark pines are the principal hosts, the disease has occurred at only a few scattered locations in Alberta and British Columbia. No significant damage has been attributed to this disease in either province.

Maritime Provinces

The North American race was first detected in New Brunswick in 1971 and is now widespread throughout the province, especially in pine plantations in the northern half of the province. Little new infection has been observed since 1980 and then only in areas already known to harbor the disease.

In Nova Scotia, where the disease was first found in 1972, a few plantations of red, jack, and Scots pine suffered limited lower branch mortality during the mid-1970s. The disease was last found in Nova Scotia in 1978 and apparently has died out. It has not yet been found in Prince Edward Island.

In 1985 the disease was observed in several areas in New Brunswick: in Carleton, Restigouche, Gloucester, Northumberland, and Kings counties. The highest infection level was found near Carlo, Restigouche County, where more than 50 Scots pine were affected in a Christmas tree plantation.

Quebec

In natural forests, scleroderris canker is frequently detected on jack pine. This year, 69 observations of this pathogen were reported over the entire distribution area of this species. Although limited to pinpoint areas, damage can sometimes be significant. For example, at Lake Louise near the Daniel Johnson Dam, 100% of regenerating jack pine stems were infected with the disease; and in 75% of these trees, the trunk or more than 25% of the foliage showed symptoms of the disease. The fungus was isolated in pure culture from the majority of samples, and the Laurentian Forestry Centre (LFC) will determine the race by electrophoresis.

Scleroderris canker was also found in the Grandes-Piles (Champlain) and Duchesnay (Portneuf) nurseries. In the latter, 14% of a stock of 1500 ponderosa pine seedlings suffered from the pathogen; the stock was closely screened before shipment. These seedlings were destined for the establishment of an experimental site. At Grandes-Piles, 98 000 Scots pines and nearly 500 000 red pines were destroyed; quantities of affected seedlings were difficult to establish because of the relatively inapparent symptoms of the disease. The inspection of windbreaks and young plantations in nurseries turned up significant sources of scleroderris canker infection in Duchesnay, Ste-Luce, St-Modeste, and Trécesson. The staff of these nurseries quickly eradicated the infected material.

Ontario

The North American race of this disease continued to damage plantations in several areas in northern and southern Ontario. New infections were discovered in red pine and jack pine stands in Haughton and Patton townships, Blind River District; Recollet and Peever townships, Wawa District; and Nimitz Township, Chapleau District. The most severe damage occurred in a 100-ha jack pine stand in Recollet Township where 85% of the trees were infected and in Nimitz Township where 26.5% of a 15 000-tree red pine plantation was infected. The disease was also reported at lower infection levels in red pine and jack pine plantations in several areas in Gogama, Chapleau, Terrace Bay, and Geraldton districts.

EUROPEAN RACE

In 1975 a disease syndrome different and more serious than that normally associated with scleroderris canker in North America was reported in New York State. The disease was killing large pine trees and was serologically identified as the European race of *G. abietina*. It has since been detected at scattered locations in New Brunswick, Newfoundland, Quebec, and Ontario (see Fig. 8 for Ontario). Except in Newfoundland, the symptoms and damage caused by the European race have been indistinguishable from those of the North American race.

Maritime Provinces

The European and several other "intermediate" races have been found in New Brunswick at 11 locations since 1978. Eradication attempts at a forest nursery, in a Christmas tree plantation, and

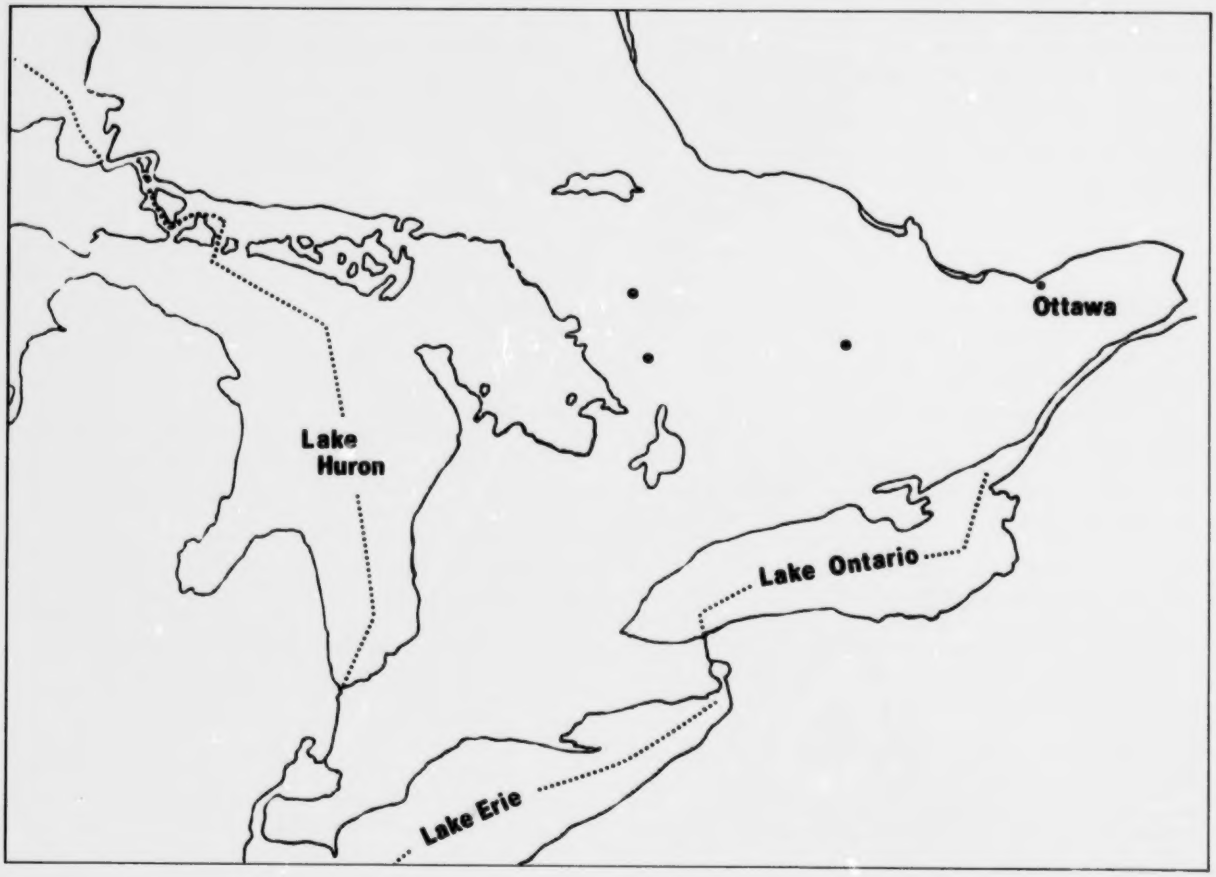

Figure 8. Positive sample points of European race of scleroderris canker of pine found in eastern Ontario.

in a commercial plantation apparently successfully eliminated the disease. The remaining eight plantations are under close annual surveillance for changes in symptom expression, which at the current stage of disease development are indistinguishable from those of the North American race. In addition, samples from each area are serologically analyzed for race determination. The fact that none of the samples since 1983 proved to be of the European race gives rise to cautious optimism regarding the future of this race in the Maritimes.

Newfoundland

The European race of scleroderris canker continued to spread on ornamental pines in St. John's, Nfld. New infections were recorded on Austrian pine throughout several areas in the city. About 60% of the trees were infected and up to 30% of the shoots showed symptoms. Many of the infected trees were pruned to eradicate this canker disease or reduce its spread. Inspection of the site on the Salmonier Line, outside of the quarantine area, where infected trees were removed in 1985 showed no new symptoms of infections. Surveys to detect scleroderris canker were also conducted in pine plantations and ornamental trees across the island and no new infections were recorded outside St. John's.

Quebec

In recent years, various plantations surveys conducted by the LFC and the Quebec Department of Energy and Resources have detected the presence in Quebec of the European race of scleroderris canker, primarily in the Outaouais administrative region. The Plant Quarantine Division of Agriculture Canada is focussing particular attention on this race of the fungus, which is more virulent than the generally encountered North American race. Accordingly, in 1985 LFC and the Quebec Department of Energy and Resources jointly planned an extensive survey to detect this race of the pathogen in southwestern Quebec plantations. The provincial Insect and Disease Protection Service conducted the field survey, while diagnosis and race identification were carried out by LFC.

The survey area covered the Eastern Townships as well as the Montreal and Outaouais administrative regions. In the Outaouais, the work focussed around an area inventoried in 1984 by FIDS–LFC known to be infested by the European race of *G. abietina*.

All pine plantations in the Montreal and Outaouais regions were visited; in the Eastern Townships, most of the plantations investigated were Scots pine destined for the production of Christmas trees. Part of the area east of the Richelieu River, however, was not inventoried because of technical reasons beyond our control. The location and mapping of sites were completed by personnel in the administrative regions and staff of the Insect and Disease Protection Service.

Because the objective of the survey was to detect the disease, each plantation was inspected along a linear transect designed to optimize the discovery of symptoms. The extent of the disease in the various sites was not noted. A total of 1585 plantations were visited (51.7% red pine, 48.0% Scots pine, and 0.3% black pine). Preliminary results indicate that 133 plantations were infected with scleroderris canker (Table 3) — 87% red pine and 13% Scots pine. Most of the infected plantations were in the 6- to 20-yr age-group.

Table 3. Extensive scleroderris canker survey in Quebec in 1985 — number of plantations visited (V) and found infected (I), by administrative region.

	Number of plantations							
	Red pine		Scots pine		Black pine		Total	
Admin. region	V	I	V	I	V	I	V	I
Eastern Twps.	5	3	106	4	-	-	111	7
Montreal	535	91	471	12	4	-	1010	103
Outaouais	279	22	185	1	-	-	464	23
Total	819	116	762	17	4	0	1585	133

To date, the LFC has identified by electrophoresis the European race of the disease in some 25 pure cultures of the fungus. The 25 plantations represented by these cultures are in all three administrative regions, but the northern part of the Montreal region seems to have the highest concentration. These are partial results, however, and further analysis and verifications will follow.

Ontario

The European race of this disease was found for the first time in Ontario in 1985. This was a direct result of an intensive program of aerial and ground surveys that the FIDs unit has carried out since 1977. The pathogen was identified from three locations in the Algonquin region (Fig. 8). Single, red pine plantations were infected in Macauley Township, Bracebridge District; and McMurrich Township, Parry Sound District; and two red pine plantations about 1 km apart were infected in Mayo Township, Bancroft District. At the first two locations the Ontario Ministry of Natural Resources clear cut and burned the plantations to eradicate the disease. Controlled ground fires will be carried out at both locations in the spring of 1986 to eliminate any infected material that remains on the ground. At the third location, in Mayo Township, a sanitation program has been carried out in which all infected material was cut or pruned and burned.

European larch canker

Lachnellula willkommii (Hartig) Dennis

Maritime Provinces

European larch canker, caused by the fungus *Lachnellula willkommii* (Hartig) Dennis, was first discovered in the Maritimes in 1980. Subsequent surveys established the distribution of the disease as widespread in southeastern New Brunswick and on mainland Nova Scotia. European larch canker has been a serious disease in many parts of Europe. The fungus is considered by most to be a primary pathogen (capable of infecting vigorous, healthy trees) and its presence in Europe has resulted in the exclusion of larch from plantation programs. In North America the fungus was found in Massachusetts in the 1920s in European larch plantations. Periodic concentrated eradication attempts apparently were successful as the disease was not found during surveys of the area in 1965; however, it was discovered in northeastern Maine in 1981.

The fungus infects mostly young trees; therefore future wood supplies may be affected. Tree mortality reduces stocking, branch mortality reduces growth, and cankers reduce wood quality. The extent to which the disease will cause damage in the Maritimes is not yet known but the potential for damage is there, and the role of the disease will have to be considered in view of increased emphasis on forest renewal and larch tree improvement programs.

In 1985 the disease was found outside the range of known distribution at only one location — south of Riversdale, Colchester County, Nova Scotia. This find represents only a minor extension. More than 50 other areas surveyed in uninfected areas in 1985 were negative.

Investigation of several aspects of the behavior of the fungus under our climatic conditions has been initiated. Results will be reported as they become available. A survey to establish age and spread pattern indicates that the fungus could have been present in the Maritimes for about two decades before its discovery and may have spread from specific areas. The study also showed a rapid decrease in incidence of infected trees with increasing distance from the southern shores of the Bay of Fundy, possibly indicating a climatic dependence.

The disease is capable of intensifying rapidly in young stands. Incidence of infected trees in a research plot increased as follows, based on fall assessments: 1982 - 7%; 1983 - 19%; 1984 - 46%; 1985 - 88%. Both stem and branch cankers were present on 30% of the trees, 40% had only branch cankers, and 16% of the trees had only stem cankers.

Greenhouse-grown seedlings of 30 populations of *Larix decidua, L. leptolepis, L. eurolepis, L. laricina,* and *L. sibirica* were planted in a heavily infected area in the early summer of 1983 to test differences in susceptibility to infection. *Larix occidentalis* seedlings were added to the test in 1985. Cankers, bearing fruiting bodies of *Lachnellula willkommii*, were found on three seedlings in the fall of 1984. By the fall of 1985, 11 of the 32 larch populations had at least one seedling infected by the disease. Details of this study are the topic of a CFS–Maritimes information report to be released shortly.

Dwarf mistletoes

Arceuthobium spp.

Dwarf mistletoes, *Arceuthobium* spp., are among the most common and destructive diseases of conifers in Western Canada, from Vancouver Island, B.C., to Lake Winnipeg, Man. The host range and geographical distribution of the major dwarf mistletoes have been generally identified through earlier surveys and collections. Five dwarf mistletoes infect major commercial tree species, including lodgepole and jack pine, western hemlock, western larch, Douglas-fir, and spruce. Each mistletoe may occur on one or more additional but usually secondary hosts, including pines, spruces, and true firs.

The dwarf mistletoes are perennial parasitic flowering plants that depend on living hosts for support, water, and most nutrients. They attack trees of all ages and cause reduction of vigor, growth, and wood quality, and sometimes mortality. Growth losses of 30-60% have been determined and their importance is frequently not recognized in the estimation of site potential. A proliferation of distorted branches ("witches' broom") or a swelling or distortion of the stem are often the most conspicuous indicators of infection. Infections develop and spread slowly with little annual fluctuation once established in the tree or stand, and surveys are therefore unnecessary each year. However, losses are persistent and increase with the age of infection. The growth reduction in terms of volume attributable to these parasites in Western Canada is estimated to be about 3.2 million m^3 annually since 1977.

Because dwarf mistletoes are easily detected, limited to specific hosts, spread slowly over short distances, and die when the host tree dies, they can be effectively controlled by cutting or pruning infected trees. Efforts to minimize reinfection of regeneration are most practical and effective when combined with forestry operations during the harvest–regeneration stage or during early stand tendings.

In some areas, dwarf mistletoes are an additional consideration in salvage harvesting and stand regeneration after an attack by mountain pine beetle. Another management constraint is the substantial but unquantified areas of forest land, frequently near processing plants, on which severely infected stands of poor quality exist or which are understocked with infected trees after incomplete harvesting. Such stands cannot now be economically harvested and regenerated.

The reduction of dwarf mistletoe losses through intensive forestry is a high priority of the British Columbia Ministry of Forests in attempting to minimize expected future wood shortages:

"Several thousand hectares of infected overstory are now being treated each year, three demonstration thinning projects have been established and prescriptions for the removal of infected, advanced regeneration are being written into harvest and regeneration plans in the province."

Lodgepole pine dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm., is widespread throughout British Columbia and has caused significant volume losses, particularly in the Cariboo region. All 18 stands surveyed in 1985 to determine the extent and incidence of dwarf mistletoe on regeneration lodgepole pine in stands susceptible to mountain pine beetle were infected. Mistletoe infection ranged from light in three stands, moderate in nine, and severe in six, based on a six-class rating system. Infection of more than 1700, 12-yr-old regeneration pine in 16 of the 18 stands averaged 19%. Such mistletoe-infested understory should not be relied on for satisfactory regeneration.

Decline and dieback and stress-related disorders

Maple Dieback

Observed since 1982, maple dieback is the most important pathological problem in Quebec hardwood forests. In 1985 the Quebec Department of Energy and Resources continued its research on maple dieback and maintained its aerial and field surveys.

The network of sample plots developed in 1983 and 1984, with 130 semipermanent units, was increased to 196 units in 1985. The 66 new sample plots were located in areas primarily around the sector where dieback has been most evident, namely the counties of Rivière-du-Loup, Montmagny–l'Islet, Bellechasse, Lotbinière, Orford, Brome–Missisquoi, Shefford and Richmond, and the north shore of the St. Lawrence between the counties of Portneuf and Gatineau. Each of these sample plots underwent a phytoecological study between June 3 and October 15. Several variables were measured on trees and shrubs, and herbaceous vegetation was evaluated; soil type, drainage, slope, exposure, and altitude were also determined. The Insect and Disease Protection Service of the Quebec Department of Energy and Resources participated in this research by assessing the dieback rate of each tree in the arborescent stratum and noting the various stem defects as well as the presence of depredatory agents (insects and diseases). The general state of health of these 66 sample plots was thus determined by analyzing results from the approximately 5500 sampled trees, the majority of which were sugar maples (Table 4). Furthermore, the number of trees suffering dieback per sample plot varied widely (between 10 and 100%) and the average incidence was 55% for all sample plots.

The general survey conducted by the Insect and Disease Protection Service during the season showed dieback symptoms throughout the maple bush bioclimatic zone. As reported in previous years, the areas most affected by maple dieback are south of Quebec City, Trois-Rivières, and the Eastern Townships, but analysis of the 158 surveys received by our laboratories shows that dieback now affects the north shore of the St. Lawrence in a corridor between Ste-Anne-de-Beaupré and Louiseville; areas in the Laurentians, in northern Montreal, Lanaudière, the main river valleys in the Outaouais region, and the Témiscamingue region also contained stands affected by dieback. The sugar maple remains the most frequently affected tree species, but many surveys indicate that yellow birch, red oak, beech, various species of ash, and black cherry are also affected. In the northwestern administrative region, more specifically in the Témiscamingue area, analysis of surveys shows that the number of stems affected in each of the 12 maple stands observed exceeds 60%; conversely, damage related to the percentage of foliage missing in crowns varies between 6 and 50%. The affected species were sugar maple and yellow birch. The affected forest area lies east of a line drawn between the towns of Ville-Marie and Témiscamingue; many observations were noted north of the town of Témiscamingue, near Lake Kipawa, and also west of the town of Belleterre.

Table 4. Distribution of the 66 sample plots by dieback class

Dieback classes (average percentage of missing foliage)	Number of sample plots (%)
5% or less	17 (26.0)
6 – 25%	37 (56.0)
26 – 50%	9 (13.5)
51% and over	3 (4.5)
Total	66

The provincial Insect and Disease Protection Service also conducted an aerial survey in 1985 to determine the scope of dieback in maple stands. The helicopter flyover covered an area of 25 110 km^2 (2 511 000 ha) bounded on the west by Lake Champlain, the east by St-Pascal-de-Kamouraska, the south by the U.S. border, and the north by the St. Lawrence plain. A total of 5336 km^2 of maple forest zones were included in the survey area. The survey was conducted from July 31 to August 24 and required 190 h of flight time.

Assessment of the degree of crown dieback was based, as in previous surveys, on the average proportion of missing foliage over the entire stand. The method used in 1985, however, improved data collection and increased the accuracy of the estimate. All maple stands had first been charted on 1:50 000 topographical maps used for aerial navigation and information gathering purposes. Four classes of dieback were used: 1–10%, 11–25%, 26–50, and 51% or more.

Healthy maple stands and the presence of stem mortality in stands were also recorded. Because the lowest class of dieback (1-10%) could not be differentiated aerially from any other "normal" natural phenomenon that might affect the appearance of foliage, slightly affected areas were grouped with healthy areas; maple stands entirely free of damage symptoms, however, were rarely observed.

Results show that nearly 40% of the maple stand area, surveyed by air, fell into dieback classes above 10%. Stem mortality was also recorded in 61% of the maple stands affected by dieback. The Beauce, Frontenac, Wolfe, Mégantic, and Arthabaska census divisions suffered the most damage: the strongly affected area is in a triangle formed by the municipalities of Victoriaville, St-Joseph-de-Beauce, and Lac-Mégantic. Abundant but less severe damage was recorded along the outskirts of this territory, in an area bounded on the west side by the municipalities of Asbestos and Coaticook and on the east side by the municipalities of Armagh and Lac-Etchemin. Damage lessened gradually toward the eastern and western boundaries of the inventoried territory.

The accuracy of the aerial survey was verified by comparing its results with data collected on the ground in 85 maple stands (193 sample plots). Dieback estimates proved similar in 88% of maple stands. The difference between the two assessments (12% of maple stands) was observed generally in the case of class-limit dieback levels: recorded differences are thus negligible and demonstrate the reliability of the aerial survey. The average dieback level estimated on the ground is approximately 7% in the aerial survey's "healthy or little affected" class, 18% in the 11–25% class, and 33% in the 26–50% class. Only one of the maple stands evaluated on the ground was placed in the 51% or more class, based on an observed average dieback level of 54%.

In 1984 in response to various concerns, the Ontario FIDS unit conducted a dieback survey in 34 sugar maple stands in southern Ontario. A minimum of 100 trees were examined in each stand. Altogether, 22.7% of the trees exhibited dieback symptoms ranging from minor in most cases to severe in about 6% of the total. In all cases, the damage was the result of normal attrition caused by insect, disease, or abiotic factors.

In 1985, again in response to concern from various groups, the same stands were reexamined to determine whether any change in their status had occurred. In all cases, no further deterioration was evident and in a few instances the trees appeared to be in better condition than in the previous year. In addition, numerous other stands were examined as part of routine surveys and in response to inquiries from various agencies and individuals. No unusual damage was found and any dieback observed was caused by agents that normally occur in the forest.

Red Oak Decline

In the mid - and late 1970s oak decline was evident in several areas in southern Ontario, particularly in the central region. The oak leaf shredder was considered to be a major predisposing factor in the condition. In 1977, 13 permanent sample plots of 100 trees each were established across the southern part of the province to chart the course of this phenomenon and, if possible, to determine some of the factors involved. Of the original 1300 trees, a total of 130 trees or 10% of the total have died, 5 of which succumbed during the past year. In spite of this, the overall condition of the surviving trees has improved steadily over the past several years. This improvement coincides with a substantial decline in oak leaf shredder populations.

Deterioration of White Birch

The deterioration of white birch along the Bay of Fundy is discussed in the following chapter, "Acid Rain National Early Warning System."

Acid Rain National Early Warning System

Acid rain has been a global concern for the past few years and the effects of impurities in the air on lakes, buildings, and the forest are becoming more apparent in many parts of the world.

"Acid rain" means more than just rain with lower than normal pH. It has become the popular generic term encompassing all forms of air pollution — wet precipitation, dry deposition, ambient gaseous concentrations of pollutants, and airborne particulates including heavy metals. These pollutants, alone or in combination, may directly or indirectly affect the health of Canada's forest — their normal development, the production of wood, or the forests' role in providing a healthy environment.

Concern over the future of Canadian forests has intensified as a result of the alarming tree mortality observed in other parts of the world. The Acid Rain National Early Warning System (ARNEWS) came into being in early 1984 when the Canadian Forestry Service decided to establish a national program to detect, clearly and accurately, early signs of acid rain damage to Canada's forests before damage becomes obvious (Figs 9 and 10).

The objectives of the program are:

1) to detect the possible damage to forest trees and soils caused by acid rain or to identify the damage sustained by Canadian forests (trees and soils) that are not attributable to natural causes or management practices;

2) long-term monitoring of vegetation and

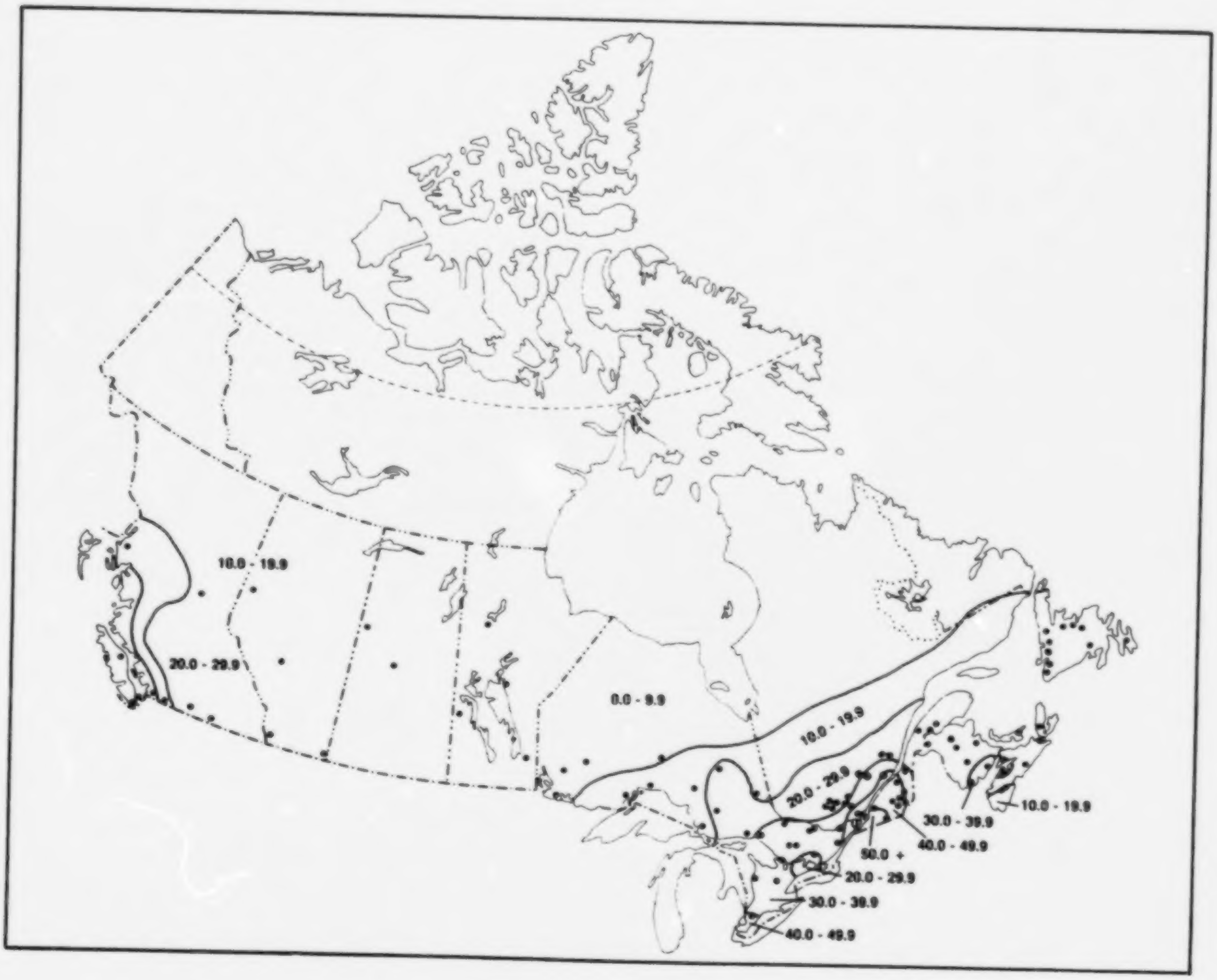

Figure 9. Acid Rain National Early Warning System — location of ground plots and acid rain zones by concentration of SO_4 deposition (kg/ha/yr).

soils to detect future changes attributable to acid deposition and other air pollutants in representative forest ecosystems.

The Forest Insect and Disease Survey was given responsibility for (1) plot establishment, (2) aboveground parameter monitoring and sampling, and (3) providing assistance in obtaining foliage and soil samples for chemical analysis.

Permanent plots are to be maintained in all regions of Canada (Figs 9 and 10) to monitor:

1) the condition and changes in the condition of the forest stand;

2) the presence and fluctuation of biotic and abiotic factors that affect the condition of the forest (insects, diseases, stand changes, temperature, etc.);

3) the changes and symptoms that indicate factors not attributable to (2) that could be early signs of acid rain damage; and

4) the effect of acid rain on the condition of the various economically important tree species.

Without close monitoring of all the factors mentioned, the expected, initially subtle, effects of acid rain cannot be isolated and identified. In particular, attention was directed to symptoms reported to be typical of acid rain damage in West Germany, namely casting of green or uncharacteristically shaped needles, premature discoloration and shedding of needles, unexplained dieback, early flattening of tree crowns ("storks nesting"), abrupt decline in foliage or annual ring growth, etc.

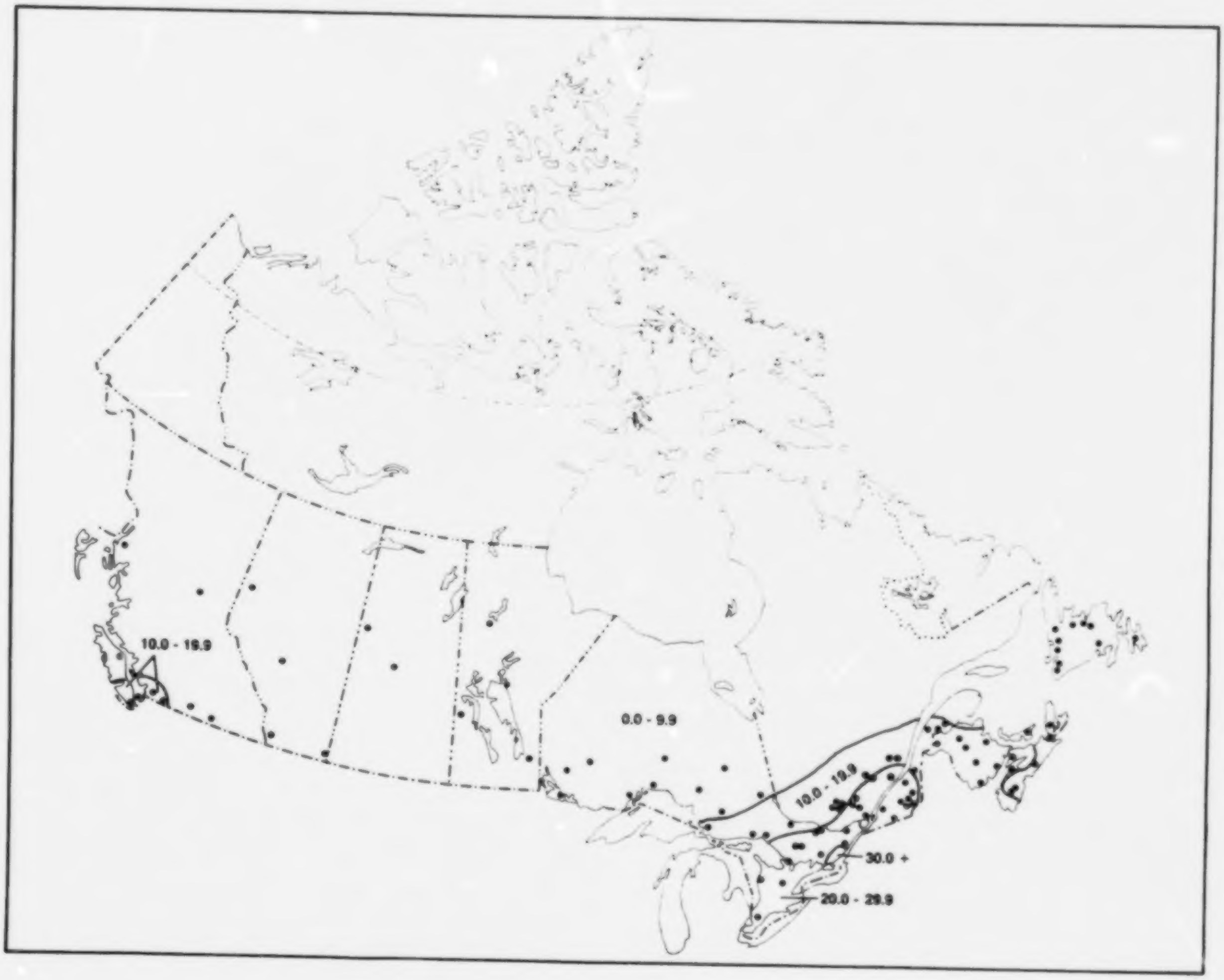

Figure 10. Acid Rain National Early Warning System — location of ground plots and acid rain zones by concentration of NO_3 deposition (kg/ha/yr).

Newfoundland

The acid rain plots established in 1984 throughout Newfoundland were monitored this year and the information collected, analyzed, and computerized for future references. An additional plot was established near Gull Pond in southeastern Newfoundland in conjunction with a Department of Fisheries and Oceans research study being conducted in that area.

Maritime Provinces

In the Maritimes, 15 permanent ARNEWS plots, representing important forest species and geographical areas were established in 1984. In 1985 all plots were visited monthly from June to September to determine forest insect and disease conditions, detect "acid rain" symptoms, observe seed crop and/or fall discoloration, and collect ground vegetation samples. In August detailed assessments of all plots were carried out following the procedures established for the national system which was developed by the Maritimes FIDS unit. Foliage and soil samples were collected for analysis from 5 of the ARNEWS plots. The measurement of the increment cores collected in 1984 has been completed (10 cores per species constituting at least 10% of stand per ARNEWS plot) and the collection of 20 additional cores per species per plot should allow a meaningful analysis of the results.

Tree mortality on all plots increased from 8.3 to 9.3% since 1984. The white birch problem continued at Martin Head (ARNEWS plot no. 206) but no other unexplained problems were encountered on any of the other plots. Most of the data collected is awaiting analysis.

Two additional plots have been established at the request of and in cooperation with Frasers Inc. in northwestern New Brunswick. Those will be monitored jointly with the company in the future.

In addition to the work on permanent plots, the results of observations for signs of possible acid rain damage were recorded for most of the 248 locations where detailed pest condition assessments were made. Special attention was directed to the number of years of needle retention on coniferous species.

Forest Insect and Disease Survey personnel are always on the lookout for unusual or unexplained forest conditions, some of these conceivably suspect for acid rain damage. In 1985, in the course of general surveillance, an unexplained deterioration of white spruce was observed in northern New Brunswick. The condition involved areas of several hundred hectares in the vicinity of Squaw Cap (elevation 483 m), Slate Mountain, and Mann Mountain in Restigouche County. Mainly mature trees are affected but other age-classes are also deteriorating to some extent. In the southern part of the province red spruce was found deteriorating at many locations on Deer Island, Charlotte County. Although trees in many of these areas have been defoliated in the past by the spruce budworm, this does not adequately explain the conditions observed. Both of these problem areas require further investigation.

Deterioration of White Birch — Since 1979, early leaf browning and premature leaf drop of white birch occurred annually in southern New Brunswick and, in some years, in Nova Scotia in western Cumberland County along the Bay of Fundy. Browning, severe every year except in 1982, develops quickly and is characterized by chocolate-brown discoloration and a scorch-like appearance, which at times is restricted to leaf margins. The affected leaves curl and start dropping as early as mid-August. It was observed that some leaves that developed in the latter part of the season remained green while older leaves on the same twig turned brown. Although mainly a condition of white birch, similar symptoms were observed in 1980 and 1981 on other deciduous vegetation including alder, mountain ash, and mountain maple. The condition occurs along a coastal strip of 1–15 km wide and extends inland as far as 30 km, mainly along low-lying areas.

In 1985 the condition was present again in essentially the same areas as in previous years. Detailed weekly observations on the mainland in southern New Brunswick revealed the following:

1) The first evidence of leaf spotting on white birch was present at locations from Pennfield, Charlotte County, to Martin Head, St. John County, by June 27.

2) Foliage discoloration was conspicuous throughout the area by August 5 and unexplained leaf discoloration occurred, in addition to that on white birch, on alder, largetooth aspen, trembling aspen, and some ground vegetation at a few locations.

3) The condition was somewhat less intense than in 1984 and appeared more patchy than last year. One unusual observation was the presence this year of individual or groups of white birch trees that remained green within severely discolored areas.

4) Twig, branch, and tree mortality of white birch were commonly observed in the affected areas.

5) Foliage insects and diseases of birch were present throughout the area, the most common being the leaf spot fungus *Septoria betulina*. This fungus was first found fruiting July 15 near Saint John.

In general, light browning started near Chamcook, northwest of St. Andrews, Charlotte County, and increased in intensity to the east towards Saint John. East of the city, entire hillsides were brown near the coast between Fairfield and St. Martins and beyond to near the Westmorland County line. By late August many trees had thin tops from premature leaf drop.

White birch foliage browning also occurred on the three islands (Campobello, Deer, and Grand Manan) and at the "tip of the Fundy funnel" in both New Brunswick and Nova Scotia.

White birch is in very poor condition in some of these areas. The foliage is thin even before the early browning appears, crown dieback with dead twigs and branches is evident, and many trees are dead. The cause of foliage discoloration and deterioration of white birch remains unknown. Several organisms are associated with this condition but none of them, alone or in combination, satisfactorily explains the situation.

The leaf spot fungus *S. betulina* has been consistently present on the affected trees and in 1982, when the condition was least severe, accounted for much of the leaf browning. This fungus is known to have caused severe browning elsewhere in the past but not on such a large scale and not for such an extended period. Its association with the condition is an inescapable fact. However, where the fungus is present on white birch in other parts of the Maritimes, the symptom expression is different from that found along the Bay of Fundy. Further, *S. betulina* does not account for the leaf browning observed on other vegetation.

Bronze birch borer, *Agrilus anxius* Gory, has been active in the area and was implicated in the death of many trees. The insect attacks only weakened trees and therefore cannot be considered a primary factor. However, the preponderance of infested locations in a band roughly parallel to the Bay of Fundy indicates where in the Maritimes white birch is in the worst condition.

Birch ambrosia beetle, *Trypodendron betulae* Swaine, another insect normally considered secondary, has a wider distribution than the bronze birch borer but the pattern of occurrence is essentially the same for both insects — another indicator of unhealthy white birch.

Birch scale, *Xylococculus betulae* (Perg.), was found infesting 21% of the still living trees on 11 plots examined in southern New Brunswick in 1985 (range 0–67%). This compares with an average of 95% on the same trees in 1984 and 34% in 1983. The impact of the insect on the trees is unknown as is the reason for the great fluctuation in population levels. (It is not a sampling problem.)

The mite species *Acaphylla distata* Keif. was found at high populations on white birch foliage at Martin Head, St. John County, N.B., towards the eastern edge of the severely affected area in 1985. Although this organism is not normally considered a serious pest, high populations can cause bronze-brown discoloration and premature leaf drying. The problem usually occurs only in localized areas. Eriophyid mites, of which this species is a member, are known to thrive on hosts stressed by other factors.

Other factors must act as predisposing agents since the organisms mentioned are only indicators that white birch is in a weakened condition. Abiotic factors such as drought, past and present logging operations, road salting along highways and in urban areas, ocean salt spray in coastal regions, global climatic changes, and increased emissions from automobiles and from industrial sources, both near and far, have all been advanced as possible explanations for forest damage. Some of these do not apply to the Bay of Fundy area, while others and some additional factors may apply.

Quebec

In 1985 the second half of this project was completed, creating a total of 25 sample plots in Quebec, located in softwood, mixed, and hardwood stands. The principal selection criteria for plots were as follows: economic importance of forest species, quantity of acid precipitation falling in the area, and relative sensitivity of soil to such precipitation.

In each sample plot, all trees are identified, located on maps, and the normal dendrometric data are taken. Each tree was given careful visual examination twice per growing season to detect any early symptoms of acid rain damage. Numerous detailed observations and measurements of foliage and growth in general were also made. Every five years, complete analyses are to be conducted of soil, foliage, and radial trunk growth.

Ontario

In 1984 in keeping with its new responsibility as part of a national early warning system for acid rain, the Ontario FIDS unit established 13 study plots across the province. In 1985 an additional 12 plots were installed to complete the Ontario portion of the system. The 25 plots were located in strategic areas in various acid deposition zones. They are established in stands representing the major commercial tree species in Ontario including white spruce, black spruce, jack pine, white pine, Norway spruce, white birch, yellow birch, and sugar maple. On each plot such parameters as vertical and radial growth, crown structure and density, mortality, incidence of insect and disease attack, and specific acid rain symptoms are measured. In addition, subplots have been established at each location for the study of ground cover plants. Chemical analysis of foliage samples from the plots is presently underway and soil sampling for chemical analysis will be carried out in 1986.

Prairie Provinces

In the Prairie provinces, 10 permanent ARNEWS plots were established in 1985; four in Manitoba, two in Saskatchewan, and four in Alberta. Major tree species represented in the plots are jack pine, lodgepole pine, white spruce, black spruce, and aspen. Parameters such as vertical and radial growth, crown structure and density, mortality, and incidence of insect and disease attack have been measured. Soil and foliage sampling and analyses have also been completed.

British Columbia

Rainfalls as acidic as pH 4.6 are recorded in southwestern British Columbia, where combined with some sensitive soils having low buffering capacity, the potential for forest damage is clearly recognized.

Six additional CFS–FIDS Acid Rain National Early Warning System (ARNEWS) permanent plots were established in five forest regions in 1985 and the three plots established in southwestern British Columbia in 1984 were examined. The new plots were near Campbell River and Chilliwack in the Vancouver region, near Penticton in the Kamloops region, near Castlegar in the Nelson region, northeast of Prince George and near Terrace in the Prince Rupert region. Additional plots will be established in 1986.

To obtain an immediate assessment of the condition of the forests in British Columbia, FIDS rangers made additional observations at 65 of the province-wide permanent sample sites (PSS) monitored annually for insect occurrence and population levels. Particular attention was directed to symptoms reported to be typical of acid rain damage in West Germany. Site assessments were distributed among the soil sensitivity zones with 74% low, 6% moderate, and 20% high. All sites were in the less than 10 kg/ha/yr wet sulphate deposition zone. Trees were healthy at 90% of the PSSs. At 10% of the sites, mainly in the Kamloops region, trees had thin crowns, frequently because of current or recent insect feeding. About nine tree species and numerous ground cover species were observed. Although long-term or indirect effects may be accumulating, all obvious damage encountered could be accounted for by current or previous pest conditions.

The collected soil and foliar samples are being analyzed to determine the concentrations of key elements such as nitrogen, phosphorus, potassium, calcium, magnesium, aluminum, iron, copper, zinc, and manganese. A 13-yr historical record of water quantity, quality, and chemistry for one area in the UBC Research Forest and an annotated listing of ongoing and planned acid rain studies in British Columbia, Yukon, and the U.S. Pacific northwest were completed (see "Selected Bibliography").

Special Surveys

Cone and seed pests

Maritime Provinces

Cone rusts, because of their potential to interfere with seed production, are among those forest diseases that may have a direct impact on all aspects of forestry in both the short and long term.

Pucciniastrum americanum (Farl.) Arth., the cone rust on white spruce (alternate host: raspberry), which caused severe infection throughout New Brunswick in 1984, has been largely absent on cones in 1985. The rust was present and abundant on the alternate host, so the lack of infected cones was likely the result of the much reduced cone crop. Infected cones were found only at a few locations in New Brunswick and at McKenzie Point in Cape Breton National Park, Inverness County, Nova Scotia, where 9% of the white spruce cones were infected.

The fungus, which also infects needles, may have been found in a seed orchard in Albert County, New Brunswick. However, because of the developmental stage of the fungus, no positive identification was possible.

Results of a study on the effect of infection on seed quantity and quality indicate that while light infection had no apparent effect on either the total number of seeds per cone or the percent of sound seed, moderately affected cones produced fewer seeds and fewer of these were sound than in healthy cones. When infection was heavy all the seeds were destroyed.

Quebec

In the last 5 yr, the Insect and Disease Protection Service of the Quebec Department of Energy and Resources has performed laboratory analyses of 40 610 cones harvested from 10 softwood species in the nine administrative regions of Quebec. The main objective of this survey was to gather relevant information on the identification and importance of the principal cone and seed pests in Quebec affecting forest species used primarily for reforestation.

This sampling of cones and seeds started in 1981, when 6820 white spruce, black spruce, jack pine, red pine, white pine, and Scots pine cones were examined (Quebec Forest Insect and Disease Survey, 1981 annual report, Survey Division, Entomology and Pathology Service, Quebec Department of Energy and Resources). In 1982 a total of 4740 cones gathered from white spruce, black spruce, red pine, and jack pine were also examined (Quebec Forest Insect and Disease Survey, 1982 annual report). Harvests in this 2nd yr of sampling were made primarily in 58 stands of plus trees chosen for their exceptional phenotypes. A minimum of five trees per stand, preferably containing an abundance of cones and about 20 m apart, were selected and sampled primarily in the upper two-thirds of the crown, without considering exposure. Only 1st-yr cones were harvested from spruce and 2nd-yr cones from pine. The number of cones to be harvested per stand varied according to the species sampled: for jack pine, the number was set at 25; for red pine, at 50; for white spruce, at 150; and for black spruce, at 250.

In the last 3 yr, this special survey of cones and seeds was integrated into the seasonal field activities of technical staff members of the Survey Division, Insect and Disease Protection Service. The experimental protocol used for cone harvesting in 1982 was again applied. The minimum number of cones to be harvested per stand was also the same; in addition, for eastern white pine, the number was set at 25 and for larch, sampled primarily in July, at 50. A total of 29 050 cones were harvested during 1983, 1984, and 1985.

Great care should always be exercised in any comparative analysis of the importance and annual damage of cone pests. The activity of these insects, which are often specific to a given host, depends on the cone production dynamics of the plant, and many insects are characterized by a larval diapause that can last as long as 5 consecutive years in some cases. A cone reduction often leads to a significant increase in the infestation rate, as insects occupy the maximum number of cones available. An excellent cone crop in the next year could lead to a significant reduction in the infestation rate because food would be abundant but insect numbers small in absolute value. This has been clearly illustrated over the last 3 yr by the spruce seed moth *Cydia strobilella* (L.) (= *Laspeyresia youngana* Kft.), which is the most formidable pest of white spruce seeds. Among other white and black spruce cone and seed pests, the spruce cone maggot, *Delia anthracina* (Czerny), a dipter that attacks the seed itself, was found regularly and may be responsible for considerable annual damage. Pyralids of the genus *Dioryctria*, and primarily the Douglas-fir coneworm *Dioryctria abietivorella* (Grt.), were found frequently in both spruce and pine cones. Damage caused by pyralids is often perceived as secondary and nonspecific, because larvae feed primarily on the outside of cones by chewing scales. Careful examination of cones attacked by this group of insects, however, shows significant and highly localized internal damage from which seed yield reductions can be anticipated. Examination of several spruce and pine cones reveals obvious external signs of larval damage characteristic of lepidoptera; the absence of insects, however, prevents any specific identification. In red pine cones, the red pine coneworm *Eucosma monitorana* Heinr. was the insect most frequently found.

Ontario

In 1985 the FIDS unit conducted a study to determine the pests affecting red pine seed and cone production in southern Ontario. Each ranger in southern Ontario attempted to collect 100, 2nd-yr cones that were still in the green stage before hardening off occurred. The cones were submitted to the Sault Ste. Marie laboratory for dissection and analysis. About 368 cones were submitted and examined. Of this total, 322 cones or about 87.5% were damaged by one or more agents. The overall seed loss within the damaged cones averaged 47.8%. The principal insects causing the damage included the red pine cone beetle, *Conophthorus resinosae* Hopk.; the red pine coneworm, *Eucosma monitorana* Heinr.; the webbing coneworm, *Dioryctria disclusa* Heinr.; the Douglas-fir coneworm, *D. abietivorella* (Grt.); a dipterous insect, *Resseliella* sp.; and lepidopterous insects of unknown species. A single disease, a tip blight, *Sphaeropsis sapinea* (Fr.) Dyko & Sutt., was encountered along with mechanical damage of unknown origin. Complete results are summarized in Table 5.

A survey of jack pine cones was the northern Ontario counterpart to the southern Ontario red pine cone survey. The methodology of the survey was the same, in that 100, 2nd-yr green cones were collected from each location and sent to the Sault Ste. Marie laboratory for dissection and analysis. A total of 900 cones were examined of which 383 or 42.6% were damaged, damage of the cone ranging from 7 to 99%. In damaged cones seed loss averaged 51.1% and ranged from 23 to 100%. The principal agents causing the cone and seed damage included a tip blight, *S. sapinea*; the red pine cone beetle, *C. resinosae*; the Douglas-fir coneworm, *Dioryctria abietivorella*; the webbing coneworm, *D. disclusa*; the eastern pine seedworm, *E. toreuta* (Grt.); a cone resin midge, *Resseliella* sp.; the white pine coneworm, *E. tocullionana* Heinr.; and the jack pine budworm, *Choristoneura pinus pinus* Free. In addition, an unknown agent caused mechanical damage to some cones while others were damaged by unknown lepidopterous larvae. A summary of the results of the survey is shown in Table 6.

Table 5. Summary of red pine cone and seed damage at four locations in southern Ontario in 1985

District	Location	No. of cones examined	Cones damaged %	Seed loss within damaged cones %	Principal causes of seed loss
Pembroke	Shrinehill Richards Twp.	100	83	39	*Conophthorus resinosae* Lepidopterous larvae Unknown (probably mechanical) *Dioryctria* sp. *D. abietivorella*
Lindsay	Orono Clarke Twp.	100	94	69	*D. disclusa* *Eucosma monitorana* *Dioryctria* sp. *D. abietivorella* Lepitopterous larvae Unknown (probably mechanical)
Huronia	Craighurst	100	81	51	*E. monitorana* *D. disclusa* *Sphaeropsis sapinea* *C. resinosae* *Resseliella* sp. Unknown (probably mechanical)
Simcoe	Turkey Point	68	94	32	*E. monitorana* Lepidopterous larvae *Resseliella* sp. Unknown (probably mechanical) *D. abietivorella* *Gelechiidae*

Table 6. Summary of jack pine cone and seed damage at nine locations in northern Ontario in 1985 (based on examination of 100 cones at each location)

District	Location (twp.)	Cones damaged %	Seed loss within damaged cones %	Principal causes of seed loss
Kenora	Melick	16	47	*Sphaeropsis sapinea* Unknown Lepidopterous larvae *Dioryctria abietivorella*
Sioux Lookout	Lomond	37	23	Unknown *D. abietivorella* *Conophthorus resinosae* *S. sapinea* Lepidopterous larvae *Eucosma toreuta*
Thunder Bay	Paipoonge	13	69	*C. resinosae* Lepidopterous larvae *E. toreuta* *D. abietivorella*
Geraldton	Kimberley Clark Nursery	73	69	Unknown *D. abietivorella* Lepidopterous larvae *Resseliella* sp. *E. toreuta*
Kapuskasing	Faquier	99	48	Unknown *D. disclusa* *D. abietivorella* Lepidopterous larvae
Blind River	Rose	7	49	*Resseliella* sp. *D. abietivorella* Lepidopterous larvae
Espanola	Merritt	26	28	Unknown *Choristoneura pinus pinus*
Gogama	Garribaldi	95	100	Unknown Lepidopterous larvae
Temagami	Strathcona	17	27	Lepidopterous larvae Unknown *Resseliella* sp. *D. disclusa*

British Columbia

Cone crops in coastal and interior stands, although generally light, were slightly greater than in 1984. Cone and seed pests occurred to varying degrees in 80% of the 74 conebearing stands sampled province-wide. Major pests included Douglas-fir cone moth, *Barbara colfaxiana* (Kft.), which infested up to 82% of the cones in parts of the Nelson region. Douglas-fir coneworm, *Dioryctria* *abietivorella* (Grt.), infested 63% of the cones sampled in the Nelson region and 2% on Vancouver Island. Douglas-fir seed chalcid, *Megastigmus specularis spermotrophus* Wachtl, occurred in 75% of the cones in the Nelson region, but only in an average of 6% (range 0-30%) on Vancouver Island. Spruce cone maggot, *Hylemya anthracina* (Czerny), and spruce seed moth, *Cydia strobilella* (L.), were common in white and Sitka spruce in parts of the Prince Rupert and Cariboo regions, and infested up to 72% of the Engelmann spruce cones in the Nelson region. A spruce cone rust, *Chrysomyxa pirolata* Wint., infected 10% (range 3-18%) of the Engelmann spruce cones in four stands in the Nelson, Cariboo, and Prince Rupert regions, but was not evident in other regions.

Western white pine cone crops, assessed at 64 coastal and interior wet belt areas in support of a co-operative research study, were medium to heavy in 80% of sites in the west Kootenay and in the Kamloops region, and light in the Vancouver region.

Significant pests in the 12 coastal and 9 interior seed orchards surveyed in 1985 included Swiss needle cast, *Phaeocryptopus gaeumannii* (Rohde) Petr., common and light to severe in 8 orchards; and Meria needle disease, *Meria* sp., infected up to 10% of the Douglas-fir foliage in 3 seed orchards and two natural stands on Vancouver Island. Balsam woolly adelgid, *Adelges piceae* (Ratz.), occurred on twigs of 4% of the amabilis fir in one coastal seed orchard within the known infestation and quarantine zone. Spruce aphid, *Elatobium abietinum* (Wlk.), lightly defoliated older needles in 5 orchards and cooley spruce gall adelgid, *Adelges cooleyi* (Gill.), was common in 10 orchards. Young stock in an interior orchard were lightly defoliated by western spruce budworm, *Choristoneura occidentalis* Free., which had severely defoliated adjacent Douglas-fir stands.

Pests in young stands and plantations

Newfoundland

Surveys for balsam woolly adelgid, *Adelges piceae* (Ratz.), conducted during the past 3 yr showed that in western Newfoundland aphid damage has increased from Port aux Basques to Robert's Arm, along the coastline of Notre Dame Bay and from Badger to Gander Bay in central Newfoundland. In 1985 plots were established in forest improvement areas in western Newfoundland. Trees were tagged and classified for damage and branch samples were taken to estimate aphid population levels. Results of the survey showed that both the severity of damage and the average number of aphids per branch node had increased noticeably in the thinned stands. Also, 80% of the trees in unthinned stands and 99% of the trees in thinned stands showed symptoms of aphid attack. The increased aphid damage in thinned stands is of major concern to forest managers as these stands were thinned at considerable cost to increase wood production.

Maritime Provinces

Sirococcus shoot blight, caused by the fungus *Sirococcus conigeus* (DC) P. Cannon & Minter (previously known as *S. strobilinus* Preuss), has been known in the Maritimes for only about a decade but has been present for much longer. The fungus infects and kills newly developed shoots. Fruiting bodies are produced on the twigs, needles, and cone scales from which the spores disperse and cause new infection. Heavy attacks cause branch mortality, resulting in crown dieback and tree mortality. In the Maritimes, the disease affects red pine and occasionally spruce, although other species of pine, larch, hemlock, Douglas-fir, and true firs can also be affected. Trees of any size, from seedlings to 15 m high, are damaged or killed.

The disease is present in all three provinces but is most widely distributed in red pine plantations in Nova Scotia, west of the Colchester–Pictou and Halifax–Guysborough county lines, and in natural regeneration in the south and central part of New Brunswick. In 1985 the disease intensified in all three provinces and in many areas repeated infection has resulted in serious deterioration of red pine stands and plantations.

In New Brunswick Sirococcus shoot blight appears to be restricted to the southern part of the province. The northernmost occurrence was reported near Muzroll Brook along the Chipman–Doaktown road, Northumberland County, where the disease was severe on understory trees in a small area. Both understory and large trees were again infected at Shin Creek, Charlotte County, where further deterioration of the stand occurred in 1985. In Fundy National Park red pine trees along Hwy 114 near the headquarters area deteriorated so much in the past years that many of them were removed in the fall of 1985. Diseased trees were also observed very close to a seed orchard in Albert County.

In Nova Scotia Sirococcus shoot blight is presently much more common and more damaging in the western part of the province; however, infected stands and plantations are also spreading in eastern Nova Scotia. The infection continued at Squid Cove, Lunenburg County, and both the number of dead trees and the affected area increased over past years. In 1985, 23% of the trees were dead and in an additional 60% of the trees, more than half their crowns were dead. No trees were found in the plantation with less than 25% crown mortality. Stands in seriously deteriorating condition were observed in Stanley Management Area, Hants County; in the Chignecto Game Sanctuary, Cumberland County; near Debert, Colchester County; and in several plantations in the Rushy Lake, Yarmouth County, area. A relatively new infection center (about 2 yr old) was found near Diligent River, Cumberland County. In eastern Nova Scotia, the disease intensified in a small plantation, first found infected in 1984, in the Perch Lake road area, Pictou County. This plantation is surrounded by numerous, healthy, red pine plantations and its destruction was recommended to prevent the spread of the disease.

The deterioration of pine stands by this disease in western Nova Scotia and the spread to plantations in the eastern half of the province, where red pine has been a major plantation species in recent years, makes Sirococcus shoot blight one of the major plantation problems in Nova Scotia.

In Prince Edward Island in 1985 the infection intensified in a small 33-yr-old red pine plantation at Iona, Queens County, and on some of the fringe trees up to 30% of the shoots were infected. The fungus also caused light shoot damage to one red pine tree at Goose River, Kings County.

The browning of larch shoots and branches was reported for the first time in 1983. It was much reduced in Nova Scotia in 1984 and was not found in Prince Edward Island. The cause of the condition has been identified as *S. conigeus* (*S. strobilinus*).

Spruce budmoth, *Zeiraphera canadensis* Mut. & Free., and to a lesser degree, a closely related species, *Z. unfortunana* Powell, have been omnipresent forest pests in the Maritimes for as long as forest insect and disease records have been kept (since the late 1930s). Although widespread, insect populations have been generally low except for the occasional flare-up, usually on open-grown white spruce. The last recorded outbreak occurred in New Brunswick in the mid-1960s when spruce in parts of the southwest Miramichi and the Nashwaak River drainage system sustained moderate to severe defoliation, and in Nova Scotia in the mid-1970s when similar levels of defoliation occurred in areas along the Northumberland Strait and the Fundy coast.

Spruce budmoth, a not-too-important forest insect in mature forests, became a major pest in 1980 when it was discovered to be causing defoliation, shoot distortion, and tree deformation in white spruce plantations over large areas in New Brunswick. In 1982 over two-thirds of the 180 locations surveyed in the region were infested by spruce budmoth. At over 40% of these locations, in both New Brunswick and Prince Edward Island, defoliation and shoot damage were greater than 10% and were classed as moderate or severe at 10 and 20%, respectively, of the locations in those provinces.

In 1985 spruce budmoth populations were generally low and damage light in most of the region, except in the following areas:

In northwestern New Brunswick repeated feeding in a large area of white spruce plantations resulted not only in shoot distortion but also in some instances up to 50% of top mortality, involving all the multiple leaders that developed on the affected trees from repeated damage. Shoot damage at 13 locations in Madawaska, Restigouche, and Victoria counties ranged from 11 to 96% and averaged 31% in the plantations examined.

Research to find the most appropriate combination of control methods has been conducted in these plantations. In 1985 this included the release of the minute egg parasite *Trichogramma minutum* Riley. Early results indicate an elevated level of egg parasitism.

In Nova Scotia, ground surveys indicated that part of the 11 600-ha defoliation mapped during spruce budworm aerial surveys in Antigonish County might have been caused by the spruce budmoth (*Z. canadensis*) rather than the spruce budworm.

In Prince Edward Island 30% defoliation occurred on 90% of young white spruce trees over a small area of Bayfield, Kings County.

Ontario

Special surveys in 1985 concentrated on red pine in southern Ontario and jack pine in northern Ontario. The surveys are carried out annually to gather baseline data and determine the status of pests affecting conifer plantations.

In the red pine survey, 4650 trees were examined in 31 plantations. The results follow.

Insects — The most abundant insect was the European pine shoot moth, *Rhyacionia buoliana* (D. & S.), found on 132 trees, or 2.8% of the total. Thirty-three of the 132 infested trees had leader damage. The insect was found in all the southern Ontario regions, but most of the damage was reported from the central region.

The second most abundant insect was the red-headed pine sawfly, *Neodiprion lecontei* (Fitch), infesting 28 trees or 0.6% of the total. In most cases, the number of colonies per tree was low and defoliation was light to moderate. Infestations of this insect were confined to the eastern and Algonquin regions. The pine false webworm, *Acantholyda erythrocephala* (L.), was found on 23 trees, mostly in the central and southwestern regions, and the European pine sawfly, *N. sertifer* (Geoff.), was found on 17 trees in the same two regions. Neither insect caused any appreciable damage. Other insects that were encountered during the survey but that did not cause appreciable damage were the eastern pine shoot borer, *Eucosma gloriola* Heinr.; the red pine sawfly, *N. nanulus nanulus* Schedl; a conifer micro moth, *Holcocerina immaculella* McD.; a weevil, *Magdalis perforata* Horn; the white pine weevil, *Pissodes strobi* (Peck); an aphid, *Cinara* sp.; the European pine needle midge, *Contarinia baeri* (Prell); the pine spittlebug, *Aphrophora cribrata* (Wlk.); and the pine needle scale, *Chionaspis pinifoliae* (Fitch).

Diseases — The most common disease encountered was the pine needle rust, *Coleosporium asterum* (Diet.) Syd., found on 640 trees or 13.8% of the total. The disease was recorded in all four southern Ontario regions but the highest incidence was in the eastern region. Actual foliage damage averaged less than 10% in all cases. The second most abundant disease was the needle cast fungus, *Lophodermium* sp., which occurred on 98 trees or 2.1% of the total. Defoliation in all cases was less than 1%. The disease was found in the eastern and Algonquin regions. The only other significant disease found by the survey was Armillaria root rot, *Armillaria mellea* (Vahl ex Fr.) Kumm., found on 14 trees, 13 of which were in the eastern region.

A survey of jack pine plantations was the northern Ontario counterpart to the southern Ontario red pine plantation survey. Altogether, about 10 675 trees were examined in 56 plantations in the four northern regions. The results follow.

Insects — The most abundant insect encountered was the jack pine budworm, *Choristoneura pinus pinus* Free., found infesting 693 trees or 6.5% of the total. The insect was present in all four regions but was most prevalent in the northern and northwestern regions. Defoliation of infested trees ranged from 3% in the northern region to 14% in the north-central region and averaged 6% overall. The white pine weevil, *P. strobi* Peck, destroyed the leaders on 187 trees or 1.8% of the total. It, too, was found in all four regions but was most prevalent in the northern and northwestern regions. The eastern pine shoot borer, *E. gloriola* Heinr., was found infesting 165 trees or 1.3% of the total, 117 of which had leader damage. The largest number of trees attacked by this insect (100) was in the northern region. The jack pine tip beetle, *Conophthorus banksianae* McP., caused leader damage on 75 trees or 0.7% of the total, 58 of which were in the northern region. Other insects that were encountered in the survey but that caused only minor damage were the red pine sawfly, *Neodiprion nanulus nanulus* Schedl; the redheaded jack pine sawfly, *N. rugifrons* Midd.; a pine sawfly, *N. maurus* Roh.; the pine spittlebug, *Aphrophora cribrata* (Wlk.); the pine tortoise scale, *Toumeyella parvicornis* (Ckll.); the pine webworm, *Tetralopha robustella* Zell.; the pine false webworm, *Acantholyda erythrocephala* (L.); aphids, *Cinara* spp.; the jack pine resin midge, *Cecidomyia resinicola* (O.S.); the whitetriangle tortricid, *Clepsis persicana* (Fitch); the pine bud moth, *Exoteleia dodecella* (L.); the jack pine tube moth, *Argyrotaenia tabulana* Free.; the northern pitch twig moth, *Petrova albicapitana* (Bsk.); and the pine needle sheathminer, *Zelleria haimbachi* Bsk.

Diseases — The most commonly found disease was pine needle rust, *Coleosporium asterum* (Diet.) Syd., found on 750 trees or 7% of the total. It was widespread in all four regions but was most abundant in the northern region. In spite of this, the average defoliation caused by the disease did not exceed 2%. Another foliage disease, the needle cast, *Davisomycella ampla* (Davis) Darker, was found on 504 trees, 4.7% of the total. It was also found in all four regions, the highest concentrations in the northern region. Defoliation, however, was much higher, reaching 77% in the northern region and averaging 37% overall. Gall rust, *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka, was found on 615 trees, 5.8% of the total, of which 168 trees were classed as severely damaged. In the case of severely damaged trees, high numbers of branch galls or stem galls were present. The most severe and widespread damage by this disease was located in the northwestern region followed by the north-central and northeastern regions. Scleroderris canker disease, *Ascocalyx abietina* (Lagerb.) Shläpfer-Bernhard, was found on 83 trees, 79 of which were in the north-central region. The sweetfern blister rust, *Cronartium comptoniae* Arth., occurred on 38 trees, 21 of which were in the northern region and Armillaria root rot, *Armillaria mellea* (Vahl ex Fr.) Kumm., was recorded on 32 trees, of which 22 were in the northern region.

British Columbia

Only selected observations made in 1985 are reported, but many of these pests are perennial, common, and widespread. Warren's root collar weevil, *Hylobius warreni* Wood, killed up to 31% of the immature natural regeneration lodgepole pine in areas up to 50 ha in the Kamloops, Nelson, and Prince Rupert regions. Atropellis canker, *Atropellis piniphila* (Weir) Lohman & Cash, infected 80% of the lodgepole pine in a 20-ha site near Kamloops and 6% in the Suskwa River Valley in the Prince Rupert region. Comprehensive surveys of this perennial widespread disease have been completed and reported by FIDS periodically since the 1960s. Stem infection of young pine by western gall rust, *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka, killed 6% of the trees and contributed to stem breakage in 17% of the infected trees over about 20 ha in Manning Provincial Park in the Vancouver region.

Comandra blister rust, *Cronartium comandrae* Pk., killed 10% and infected 65% of the regeneration lodgepole pine over about 5 ha south of Prince George and killed 38% of the saplings near Burns Lake and 10% near Babine Lake. Saplings and semimature trees in selectively cut stands near Carcross and in the Hyland River Valley in the Yukon were lightly infected. Orange stalactiforme blister rust, *Cronartium coleosporioides* Arth., was found on Scots pine in a plantation at Ootsa Lake in the Prince Rupert region. This is only the second collection of this rust on this host in British Columbia.

Pathogens potentially damaging to lodgepole pine occurred at varying levels in most of the 13 sites in 6 areas of the Prince George region and Yukon Territory, to be planted with second-generation lodgepole pine in a disease resistance test. Lodgepole pine dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm., infected stands near Mackenzie and Fort St. James. Western gall rust, *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka, occurred in stands near Mackenzie, Fort St. John, Whitehorse, and Watson Lake. Rodents, or probably snowshoe hares, debarked about 25% of the regeneration pine in a site near Whitehorse where a pitch twig moth, *Petrova* sp., was also common.

About half the Douglas-fir and white pine seedlings planted in 1984 in a previously burned 25-ha site east of Revelstoke were killed by Rhizina root rot, *Rhizina undulata* Fr. Since first found in British Columbia in 1967 in association with seedling mortality, the fungus has occurred periodically in "hot" burned sites throughout the province.

Armillaria root rot, *Armillaria* sp., killed about 21% of the 10-yr-old Douglas-fir in root rot centers across a 45-ha plantation near Revelstoke.

Post-harvesting losses of planted stock to root diseases, particularly Armillaria root disease in southern interior forests and increasingly to tomentosus root disease in northern interior forests, are of significant economic importance. Successful implementation of root disease controls is frequently limited by costs.

Seedling mortality, bud damage, and defoliation of herbaceous ground cover caused by the black army cutworm, *Actebia fennica* (Tausch.), occurred for the 4th consecutive year in the Prince Rupert region. Some planting schedules were delayed. Spruce and pine seedlings at 10 of 31 recently burned planting sites in the eastern part of the region were affected. About 120 000 seedlings planted in 1985 were killed in numerous, scattered 1- to 5-ha patches. On five recently planted sites in the Quesnel Lake area of the Cariboo region, Douglas-fir and some spruce and pine seedlings were severely defoliated (range 30–99%) and up to 90% of the buds were killed. About 2000 lodgepole pine seedlings were killed near Indianpoint Lake in the Prince George region. Larvae also infested three sites east of Prince George, but seedlings were not damaged.

Trap data and numbers of cutworm pupae in the duff layer indicate continuing populations with the potential for damage to conifer seedlings in the Prince Rupert, Prince George, and Cariboo regions. A similar potential exists, based on historical evidence, in some of the 240 000 ha burned by wild fires in 1985.

Small numbers of Tachinid flies and Ichneumonid wasps parasitized cutworm larvae in some areas; there was no evidence of nuclear polyhedrosis virus.

Pinewood nematode

The pinewood nematode, *Bursaphelenchus xylophilus* (Steiner and Buhrer) Nickle, causes pine wilt disease and has been a serious disease in Japan since it was first discovered in 1905. The disease was first detected in the United States in 1979 but was recognized to have occurred much earlier. It now occurs in most of the continental states.

An intensive survey for the pinewood nematode was conducted across Canada during the 1985 field season by the Forest Insect and Disease Survey of the Canadian Forestry Service. A uniform sampling procedure (available on request) was used country-wide. The initial extractions for the nematodes were carried out by the FIDS regional units. Final identification of the nematodes obtained was made by Dr. Roger Anderson of the Biosystematics Research Institute, Ottawa. The survey is coordinated with Plant Health, Agriculture Canada, which is conducting surveys on wood chip piles in Canada.

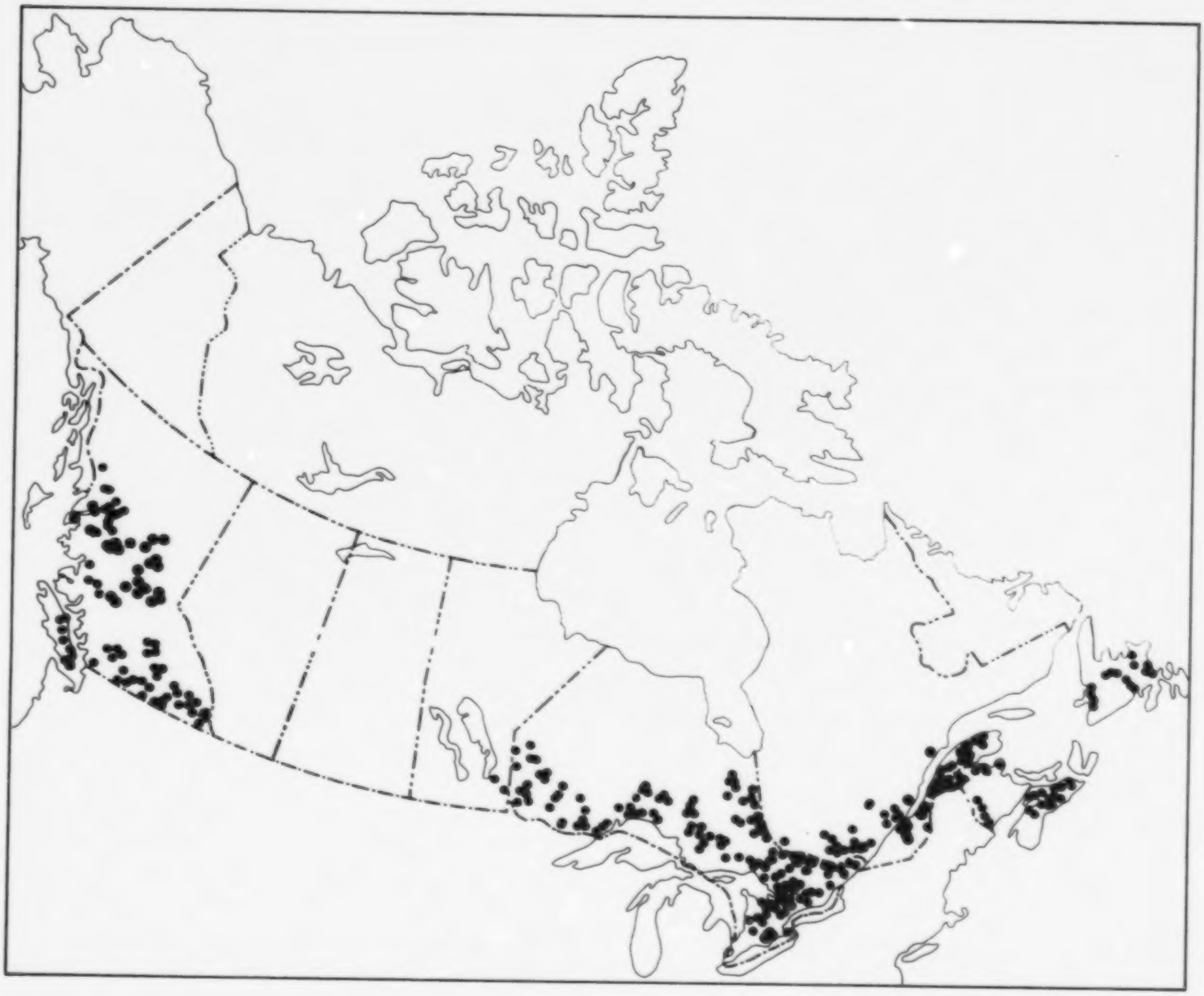

Figure 11. Intensive survey for the pinewood nematode conducted across Canada in 1985.

The survey is an extensive ongoing program so the results are preliminary. The locations sampled in 1985 covered Canada extensively (Fig. 11). The samples collected are still being analyzed by Dr. Anderson; however, results as of February 1985 are summarized in Table 7. As of that date *B. xylophilus* was found only in nine locations in southern Ontario, south of North Bay, and Pembroke. The trees with *B. xylophilus* were clearly exhibiting symptoms of pine wilt disease and died quickly.

Another *Bursaphelenchus*, termed the "m" form by Dr. Anderson, was isolated occurring mainly on balsam fir which was declining for other pathogenic reasons such as root rot, dwarf mistletoe, spruce budworm defoliation, etc. The "m" form of *Bursaphelenchus* has been found in all provinces of Canada. It is associated most commonly with balsam fir and has not been found on Scots pine. The "m" form does not appear to be pathogenic on pines or balsam fir.

Further surveys will be conducted in 1986 and results will appear in subsequent reports.

Table 7. Hosts sampled and nematodes identified

Host		
Common name	Scientific name	Nematode
Balsam fir	*Abies balsamea* (L.) Mill.	*Allantonematidae*
		Aphelenchoides sp.
		Aphelenchoides rhyntium
		Aphelenchus sp.
		Bursaphelenchus sp. "m" form
		Caenorhabditis sp.
		Cryptaphelenchus spp.
		Deladenus sp.
		Diploscapter sp.
		Dotylaphus sp.
		Ektaphelenchus sp
		Hexatylus sp.
		Laimaphelenchus
		Macrolaimus sp.
		Mesorhabditis sp.
		Mononchoides sp.
		Nematode
		Neoditylenchus sp.
		Neotylenchus sp.
		Panagrellus sp.
		Panagrobellus sp.
		Panagrolaimus sp.
		Paphelenchoides sp.
		Parasitorhabditis sp.
		Parasitylenchus sp
		Paurodontus
		Pelodera
		Pseudhalenchus sp.
		Rhabditis sp.
		Rhabdontolaimus sp
		Sphaerularia sp.
Alpine fir	*A. lasiocarpa* (Hook.) Nutt.	*Acrobeles* sp.
White spruce	*Picea glauca* (Moench) Voss	*Ektaphelenchus* sp.
Red spruce	*P. rubens* Sarg.	Nematode
Black spruce	*P. mariana* (Mill.) B.S.P.	*Aphelenchoides* sp.
		Bursaphelenchus sp. "m" form
		Ektaphelenchus sp.
		Nematode
		Parasitaphelenchus sp.
		Rhabditis sp
Englemann spruce	*P. engelmannii* Parry	
Sitka spruce	*P. sitchensis* (Bong.) Carr.	
Eastern white pine	*Pinus strobus* L.	*Aphelenchoides* sp.
		Bursaphelenchus sp. "m" form
		Deladenus sp
		Ektaphelenchus sp.
		Parasitorhabditis sp.
		Rhabditis sp.

Table 7. Cont'd. Hosts sampled and nematodes identified

Host		
Common name	Scientific name	Nematode
Red pine	*P. resinosa* Ait.	*Bursaphelenchus xylophilus* *Bursaphelenchus* sp. "m" form
Jack pine	*P. banksiana* Lamb.	*Aphelenchoides* sp. *Bursaphelenchus xylophilus* *Bursaphelenchus* sp. "m" form *Bursaphelenchus* sp. Nematode *Rhabditidae*
Scots pine	*P. sylvestris* L.	*Cryptaphelenchus* sp. *Rhabditis* sp.
Lodgepole pine	*P. contorta* Dougl.	*Acrobeles* sp. *Aphelenchoides* sp. *Bursaphelenchus* sp. *Cryptaphelenchus* sp. *Deladenus* sp. *Filenchus* sp.
Western white pine	*P. monticola* Dougl.	*Annelid* sp.
Tamarack	*Larix laricina* (Du Roi) K. Koch	*Aphelenchoides rhyntium* *Laimaphelenchus* sp. *Macrolaimus* sp.
Eastern white cedar	*Thuja occidentalis* L.	Nematode
Western red cedar	*T. plicata* Donn	

Root and butt rots

Newfoundland

Assessments were continued of the role of Armillaria root rot, *Armillaria mellea* (Vahl ex Fr.) Kumm., in the mortality of black spruce stands previously defoliated by the spruce budworm in Newfoundland. Black spruce transplanted at South Pond burned-over areas in central Newfoundland showed up to 10% mortality and was associated with this root rot. Black spruce and balsam fir trees were examined for Armillaria root rot near Joe Batts Pond west of Gander. Ten percent of the fir and 5% of the black spruce were infected. This area had a previous history of insect damage both by the spruce budworm and the foureyed spruce bark beetle.

British Columbia

Widespread mortality and decay of Douglas-fir, white and Engelmann spruce, and western red cedar throughout British Columbia occur annually, caused by fungi including laminated root rot, *Phellinus weirii* (Murr.) Gilbertson; red butt rot, *Polyporus tomentosus* Fr.; brown cubical rot, *Fomes pinicola* (Sw. ex Fr.) Cke.; white stringy rot, *Poria subacida* (Pk.) Sacc.

Pockets of mature standing and windthrown Douglas-fir infected by *Phellinus weirii* in widely scattered areas of the Fraser Canyon and Skagit River Valley in the Vancouver region were also lightly attacked by Douglas-fir beetle, *Dendroctonus pseudotsugae*. Spruce stands in several areas of the Prince George and Prince Rupert regions were infected by *Polyporus tomentosus* including 65% of the semimature trees in a stand near Mt. Robson Provincial Park; 80% of the mature trees at Stephanie Creek in the Bowron River Valley; and about 4000 mature trees, also infected by the northern spruce engraver, an engraver beetle, *Ips perturbatus* (Eichh.), scattered singly throughout the Torpy River Valley. In the Prince Rupert region, of 11% of the infected 22-yr-old planted spruce in the Telkwa River Valley, 3% were dead.

Butt rot infection of old growth western red cedar by *F. pinicola* and *Poria subacida* decayed 60% of the heartwood and caused top dieback of 10–15 m of trees over widespread areas of the Cariboo region.

Other Insects, Diseases, and Damage

Newfoundland Region

Insect, Disease, or Damage	Host(s)	Location	Remarks
Alder leaf beetle *Chrysomela mainensis mainensis* Bechst.	Alder	Western Newfoundland Terra Nova National Park	Low to moderate populations.
Anthracnose *Kabatiella apocrypta* (Ell. & Ev.) Arx	Mountain maple Red maple	Western Newfoundland	80% damage on 50% of red maple trees in Crabbes River Prov. Park; 70% incidence on a few trees near Roddickton.
Aspen serpentine leafminer *Phyllocnistis populiella* (Cham.)	Trembling aspen Balsam poplar	Western and central Newfoundland	Low populations and light defoliation.
Balsam fir sawfly *Neodiprion abietis* complex	Balsam fir	Western Newfoundland	Low populations and no significant defoliation.
Balsam twig aphid *Mindarus abietinus* Koch	Balsam fir	Western and central Newfoundland	Low to moderate populations.
Birch casebearer *Coleophora serratella* (L.)	White birch Speckled alder	Throughout Newfoundland	Extremely high populations for 3rd consecutive year throughout eastern Newfoundland, with severe defoliation on the Avalon Peninsula, Clarenville area, and throughout Terra Nova National Park.
Birch leafminer *Fenusa pusilla* (Lep.)	White birch	Western Newfoundland	Low to high numbers. Defoliation ranged from 5 to 60%.
Black knot *Apiosporina morbosa* (Schw.) Arx	Common plum	Throughout Newfoundland	On the Avalon Peninsula 100% of ornamental plum trees showed severe infection, up to 80% of the twigs having black knots.
Broom rust *Melampsorella caryophyllacearum* Schroet.	Balsam fir	Avalon Peninsula	Common and widespread, up to 30 brooms on 80% of the trees.
Eastern blackheaded budworm *Acleris variana* (Fern.)	Black spruce White spruce Balsam fir	Throughout Newfoundland	Low populations. Trace to light defoliation.
Eastern dwarf mistletoe *Arceuthobium pusillum* Pk.	Black spruce	Eastern Newfoundland	This disease continued to spread in eastern Newfoundland. The incidence nearly doubled from 1984.
European alder leafminer *Fenusa dohrnii* (Tisch.)	Alder	Western and central Newfoundland Terra Nova National Park	Low to moderate populations.
European pine shoot moth *Rhyacionia buoliana* (D. & S.)	Scots pine	CFS nursery, Pasadena	Low populations. Trace of damage.
European spruce sawfly *Gilpinia hercyniae* (Htg.)	Black spruce White spruce Balsam fir	Western Newfoundland	Low populations. No significant damage.
Fall webworm *Hyphantria cunea* (Drury)	Speckled alder	Western Newfoundland	Moderate populations; 20% defoliation near Stephenville Crossing.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Foureyed spruce bark beetle *Polygraphus rufipennis* (Kby.)	Black spruce	Central Newfoundland	Low population levels throughout central Newfoundland. Tree mortality decreased from 1984.
Green balsam looper *Cladara limitaria* (Wlk.)	Balsam fir	Western and eastern Newfoundland	Low numbers. No significant defoliation.
Greenheaded spruce sawfly *Pikonema dimmockii* (Cress.)	Black spruce White spruce Balsam fir	Western and eastern Newfoundland	Low populations. No significant defoliation.
Inland spruce cone rust *Chrysomyxa pirolata* Wint.	Black spruce White spruce	Eastern Newfoundland Avalon Peninsula	Up to 40% of the cones on 5% of the trees were affected in a black spruce regeneration site in eastern Newfoundland. A low incidence on black and white spruce on the Avalon Peninsula.
Larch casebearer *Coleophora laricella* (Hbn.)	Tamarack Japanese larch	Western Newfoundland Avalon Peninsula	Moderate numbers. Light to moderate browning on tamarack. Up to 50% of branches affected on Japanese larch in Pasadena nursery.
Larch sawfly *Pristiphora erichsonii* (Htg.)	Tamarack	Central Newfoundland Avalon Peninsula	Moderate to high populations. Severe defoliation on the Avalon Peninsula.
Leaf blister *Taphrina populina* Fr.	Lombardy poplar	Avalon Peninsula	Trace to low incidence.
Leaf rust *Melampsoridium betulinum* (Fr.) Kleb.	White birch	Western Newfoundland	10% of foliage affected on seedlings in Pasadena nursery.
Leaf & shoot blight *Pollaceia elegans* Serv.	Balsam poplar Silver poplar	Western and central Newfoundland Avalon Peninsula	A moderate incidence occurred on 40 silver poplar trees in central Newfoundland. Low incidence elsewhere.
Venturia macularis (Fr.) Müll. & Arx	Trembling aspen	Western and central Newfoundland Avalon Peninsula	A high incidence of this disease in central Newfoundland affected up to 80% of roadside trembling aspen.
Leaf spot *Cylindrosporium betulae* J.J. Davis	White birch Mountain maple	Western and eastern Newfoundland	Up to 80% of the foliage affected on 100% of the white birch regeneration in eastern Newfoundland; 80% of the foliage of 50% of mountain maple was also affected in western Newfoundland.
Septoria betulae (Lib.) West.	White birch	Western Newfoundland	30% of foliage affected on 80% of trees in CFS arboretum.
S. musiva Pk.	Balsam poplar	Western Newfoundland	Up to 10% of the foliage affected on 100% of balsam poplar trees in western Newfoundland.
Mountain-ash sawfly *Pristiphora geniculata* (Htg.)	American mountain ash	Western Newfoundland Avalon Peninsula	High populations and severe defoliation on the Avalon Peninsula. Parasite introduced annually from 1981 to 1984 from Quebec; was established in 1985 at Oxen Pond Botanic Park in St. John's.
Mourningcloak butterfly *Nymphalis antiopa* (L.)	Willow Elm	Western Newfoundland	High populations. 80% defoliation in some areas in western Newfoundland.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Nectria canker *Nectria cinnabarina* (Tode ex Fr.) Fr.	American mountain ash	Avalon Peninsula	Low incidence. Young maple affected.
Needle casts *Dothistroma pini* Hulbary	Austrian pine	Western Newfoundland	First record on Austrian pine in western Newfoundland. Up to 70% of the foliage affected on some trees.
Isthmiella faullii (Darker) Darker	Balsam fir	Throughout Newfoundland	Common but low intensity of infection.
Lophodermium pinastri (Schrad. ex Hook.) Chev.	Jack pine Red pine	Western and eastern Newfoundland	Up to 30% of the foliage of jack pine affected in a plantation on the Avalon Peninsula.
Needle rusts *Coleosporium asterum* (Diet.) Syd.	Jack pine	Avalon Peninsula	Up to 10% of the foliage affected.
Pucciniastrum epilobii Otth	Balsam fir	Western Newfoundland	Low incidence; 5% of the foliage affected.
Orange spruce needleminer *Coleotechnites piceaella* (Kft.)	Balsam fir	Western Newfoundland Avalon Peninsula	Low to moderate numbers. No significant defoliation.
Red flagging *Fusicoccum abietinum* (Hartig) Prill. & Del.	Balsam fir	Avalon Peninsula	Low incidence throughout.
Redlined conifer caterpillar *Feralia jocosa* (Gn.)	Balsam fir	Western and central Newfoundland	Low populations and no significant defoliation.
Root collar weevil *Hylobius* sp.	White spruce	Avalon Peninsula	Low populations found on Salmonier Line.
Rusty tussock moth *Orgyia antiqua* (L.)	Balsam fir Willow Speckled alder White birch	Throughout Newfoundland	Low populations.
Satin moth *Leucoma salicis* (L.)	Willow	Western Newfoundland	High numbers; 20% total defoliation on mature trees at Corner Brook.
Scab and black canker *Fusicladium saliciperdum* (All. & Tub.) Lind	Golden willow Laurel willow Willow	Throughout Newfoundland	A high incidence affected 95% of the foliage on 90% of golden willow trees causing severe damage and mortality in central Newfoundland.
Physalospora miyabeana Fukushi	Willow	Central and eastern Newfoundland	On the Avalon Peninsula 100% of ornamental laurel willow were infected with up to 30% of the foliage affected.
Shot hole *Coccomyces hiemalis* Higgins	Pin cherry	Eastern Newfoundland	Up to 50% of foliage affected near Swift Current.
Sirococcus shoot blight *Sirococcus strobilinus* Preuss	Black spruce	Central Newfoundland	Trace. Recorded on one black spruce seedling.
Snow blight *Phacidium infestans* Karst.	Black spruce White spruce	Western Newfoundland Avalon Peninsula	Damage was patchy and occurred in about 50% of black and white spruce seedlings in Pasadena nursery.
Spruce bud midge *Rhabdophaga swainei* Felt	Black spruce White spruce	Throughout Newfoundland	Population levels declined in 1985.
Spruce coneworm *Dioryctria reniculelloides* Mut. & Mun.	White spruce Balsam fir	Western Newfoundland	Low populations. No defoliation.

Insect, Disease, or Damage	**Host(s)**	**Location**	**Remarks**
Striped alder sawfly *Hemichroa crocea* (Geoff.)	Speckled alder White brich Willow	Throughout Newfoundland	High populations and severe defoliation throughout Newfoundland.
Tip blight *Rehmiellopsis balsamae* Waterman	Balsam fir	Avalon Peninsula	Up to 40% of the foliage was affected on young fir at Department Agriculture Experimental Farm at Mt. Pearl.
Western grape rootworm *Bromius obscurus* (L.)	Dogwood	Western Newfoundland	Low populations with 20% defoliation.
Willow sawfly, a *Nematus ventralis* (Cress.)	Willow	Western Newfoundland Avalon Peninsula	Moderate to high numbers. Light defoliation.
Winter drying	Conifers	Throughout Newfoundland	Common and widespread. Moderate to high incidences throughout Newfoundland.
Yellowheaded spruce sawfly *Pikonema alaskensis* (Roh.)	Black spruce White spruce	Throughout Newfoundland	Severe defoliation in central Newfoundland.

Other Insects, Diseases, and Damage

Maritimes Region

Insect, Disease, or Damage	Host(s)	Location	Remarks
Alder flea beetle *Altica ambiens alni* Harrison	Alder	Maritime provinces	Populations increased greatly in southwestern New Brunswick with pockets of moderate and severe browning common in much of Charlotte, Queens, St. John, York, and Carleton counties; throughout western Nova Scotia and at a few scattered patches at locations in Pictou, Antigonish, and Halifax counties; light browning in Queens Co., P.E.I.
Aphids *Asiphum* sp. *Cinara abieticola* (Cholodk.) *C. banksiana* P. & T. *C. fornacula* Hottes *Pemphigus* sp. *Pterocomma smithiae* (Monell) and others	Conifers Hardwoods	Maritime provinces	Present on a a wide variety of hosts at varying levels of intensity at many locations throughout the region.
Armillaria root rot *Armillaria mellea* (Vahl ex Fr.) Kumm.	Conifers	Maritime provinces	The disease is becoming more frequent in plantations where it is associated with tree mortality. It is also part of the "secondary organisms" complex implicated in the mortality of spruce budworm-damaged forest stands.
Aspen leafrollers *Pseudexentera oregonana* (Wlsm.) *Epinotia criddleana* (Kft.) Birch–aspen leafroller *E. solandriana* (L.) Darkheaded aspen leafroller *Anacampsis innocuella* (Zell.) Large aspen tortrix *Choristoneura conflictana* (Wlk.) Lightheaded aspen leafroller *A. niveopulvella* (Cham.) Spotted aspen leafroller *Pseudosciaphila duplex* (Wlsm.)	Largetooth aspen Trembling aspen	Maritime provinces	Leafrolling, particularly of trembling aspen, common at locations scattered throughout much of the region at varying levels of intensity.
Aspen serpentine leafminer *Phyllocnistis populiella* (Cham.)	Trembling aspen	New Brunswick	Common again in northern New Brunswick, affecting as much as 88% of the leaves at some locations.
Aspen webworm *Tetralopha aplastella* (Hulst) Lesser aspen webworm *Meroptera pravella* (Grt.)	Trembling aspen	Maritime provinces	Present in forest tent caterpillar-infested area in Hants Co., N.S., at varying levels of incidence and intensity; also found in New Brunswick and Prince Edward Island.
Balsam fir root aphid *Paraprociphilus americanus* (Wlk.)	Balsam fir	New Brunswick Nova Scotia	Associated with ants; caused mortality of scattered trees in three Christmas tree plantations.

Insect, Disease, or Damage	**Host(s)**	**Location**	**Remarks**
Balsam gall midge *Paradiplosis tumifex* Gagné	Balsam fir	Maritime provinces	Widespread in the region but at generally low population levels. The highest incidence (34%) of needles per tree affected was observed in a Christmas tree area in Halifax Co., N.S.
Balsam twig aphid *Mindarus abietinus* Koch	Balsam fir	Maritime provinces	Common throughout the region but populations low, the highest observation being 19% of shoots infested at a location in New Brunswick.
Balsam woolly adelgid *Adelges piceae* (Ratz.)	Balsam fir	Maritime provinces	Populations continue to be generally low.
Beech bark disease *Nectria coccinea* (Pers. ex Fr.) var. *faginata* Lohm., Wats. & Ayres Beech scale *Cryptococcus fagisuga* Lind.	Beech	Maritime provinces	Cankered trees common in beech stands throughout the region; up to 100% of the trees affected in many areas.
Birch casebearer *Coleophora serratella* (L.)	Alder Birch	Maritime provinces	Moderate or severe foliage discoloration, mostly of white birch, common in many areas in all provinces.
Birch leafminer *Fenusa pusilla* (Lep.)	Birch	Maritime provinces	Common throughout the region; caused severe or moderate foliage discoloration, mostly of white birch, in many areas.
Birch skeletonizer *Bucculatrix canadensisella* Cham.	Birch	Maritime provinces	Severe or moderate foliage discoloration, mostly of white birch, in southeastern New Brunswick, on Cape Breton Island (N.S.), and at one location in central Prince Edward Island.
Blowdown	Conifers Hardwoods	New Brunswick	About 100 ha of mixed wood with extensive blowdown in Victoria Co.; and areas in York and Northumberland counties.
Bruce spanworm *Operophtera bruceata* (Hulst)	Hardwoods	New Brunswick Nova Scotia	Widespread in New Brunswick; found in Pictou Country, N.S., but caused only light or moderate defoliation, often mixed with other hardwood insects.
Cedar leafminers *Argyresthia aureoargentella* Brower *A. freyella* Wlsm. *A. thuiella* (Pack.) *Coleotechnites thujaella* (Kft.)	Cedar	New Brunswick Prince Edward Island	Varying degrees of leaf browning in St. John and Carleton counties, N.B. Severe browning over about 2 km in Prince Co., P.E.I.
Cedar tree borer *Semanotus ligneus* (F.)	Cedar	New Brunswick	Deterioration and mortality of affected trees in Northumberland, Restigouche, and St. John counties.
Cherry casebearer *Coleophora pruniella* Clem.	Pin cherry Trembling aspen	New Brunswick Prince Edward Island	Moderate browning of scattered roadside pin cherry bushes in Albert Co., N.B., and moderate and severe browning of trembling aspen in areas up to 3 ha at 26 locations in Prince Edward Island.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Dieback	Ash	New Brunswick	Branch dieback and top mortality, sometimes associated with Armillaria root rot, in a stand of semimature trees about 1.5 ha in Gloucester Co.
Eastern blackheaded budworm *Acleris variana* (Fern.)	Balsam fir Spruce	Maritime provinces	Populations remained low.
Eastern tent caterpillar *Malacosoma americanum* (F.)	Apple Cherry	Maritime provinces	Nests common in Hants and Annapolis counties, N.S.; populations low elsewhere in region.
Elm leaf beetle *Pyrrhalta luteola* (Müll.)	Elm	New Brunswick	Browning of shade trees severe in Fredericton for the 3rd consecutive year.
Elm leafminer *Fenusa ulmi* Sund.	English elm	Maritime provinces	Leaf browning of varying intensity, often severe, in communities in much of Nova Scotia, throughout Prince Edward Island, and in Westmorland Co., N.B.
European pine sawfly *Neodiprion sertifer* (Geoff.)	Red pine	New Brunswick Nova Scotia	Found on an ornamental tree at Moncton, Westmorland Co., N.B.; present in a plantation in Lunenburg and in Colchester Co., N.S.
European pine shoot moth *Rhyacionia buoliana* (D.& S.)	Red pine Scots pine	Maritime provinces	Populations at about the same level as in 1984. Intensity of attack varied greatly between locations in Nova Scotia and Prince Edward Island. Found on ornamental red pine in Westmorland Co., N.B.
European spruce sawfly *Gilpinia hercyniae* (Htg.)	Black spruce Red spruce White spruce	Maritime provinces	Populations low; distributed widely throughout the region.
Fall cankerworm *Alsophila pometaria* (Harr.)	Hardwoods	Maritime provinces	Severe or moderate defoliation of a variety of hardwoods in natural stands and on shade and ornamental trees in many areas in all provinces.
Fall webworm *Hyphantria cunea* (Drury)	Deciduous	Nova Scotia Prince Edward Island	Nests were very common on roadside bushes in Yarmouth and Shelburne counties and numbers increased in all other areas of Nova Scotia. Noticeable increases occurred throughout Prince Edward Island.
False hornworm *Pheosia rimosa* Pack. Pepper-and-salt moth *Biston betularia cognataria* (Gn.) Rustylined leaftier *Clostera albosigma* Fitch	Trembling aspen	Nova Scotia	False hornworm in association with the other species caused moderate and severe defoliation of a few trees in Cape Breton County.
Flood damage	Ash Balsam fir Cedar Red maple Spruce	New Brunswick Nova Scotia	Small areas of flooding caused decline and mortality of a variety of tree species in western New Brunswick and Nova Scotia.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Globose gall rust *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka	Jack pine Scots pine	Maritime provinces	Present in plantations in Nova Scotia and Prince Edward Island; common in some areas of New Brunswick, mostly in jack pine plantations.
Jack pine budworm *Choristoneura pinus pinus* Free.	Jack pine Scots pine	New Brunswick Nova Scotia	Populations remained low to trace; however, pheromone trapping and larval sampling plots suggest a slight increase over 1984 levels.
Larch casebearer *Coleophora laricella* (Hbn.)	Tamarack	Maritime provinces	Moderate or severe defoliation widespread in western Nova Scotia, and in patches in eastern Prince Edward Island, and eastern Nova Scotia; populations generally low elsewhere.
Larch needleworm *Zeiraphera improbana* (Wlk.)	Tamarack	Nova Scotia	Populations remain low except for a 0.25-ha area in Pictou Co. where moderate defoliation occurred.
Larch sawfly *Pristiphora erichsonii* (Htg.)	Tamarack	New Brunswick Prince Edward Island	Populations remained low throughout the region.
Leaf blotch *Guignardia aesculi* (P.) V.B. Stewart	Horsechestnut	Maritime provinces	Moderate and severe browning at most locations where the host is present in the region.
Leafrollers on birch *Caloptilia* sp.	White birch Yellow birch	New Brunswick	Populations increased significantly in the past 2-3 yr resulting in moderate leafrolling of white birch and to a lesser extent yellow birch in much of the northern half of the province and at scattered locations elsewhere.
Leaf rust *Melampsora medusae* Thüm.	Poplar	Maritime provinces	Varying levels of infection in scattered areas thoughout Nova Scotia, severe in places; found at low levels of intensity elsewhere in the region.
	Trembling aspen	New Brunswick	Moderate near Weaver Siding, Northumberland Co., N.B.
Puccinia sparganioides Ell. & Barth.	Ash	Maritime provinces	Severe foliage discoloration in many areas in western Nova Scotia and southeastern New Brunswick. Found elsewhere at low intensity. Dieback, associated with repeated defoliation, is common in many affected areas.
Leaf spot *Drepanopeziza tremulae* Rimpau	Trembling aspen	Nova Scotia Prince Edward Island	Moderate and severe leaf browning at several areas in Richmond Co., N.S., and at Brooklyn, Kings Co., P.E.I.
Leaf & twig blight *Venturia macularis* (Fr.) E. Müll. & Arx	Trembling aspen	Martime provinces	Common throughout New Brunswick and Nova Scotia; found in one area in Prince Edward Island. Damage generally light.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Lesser maple spanworm *Itame pustularia* (Gn.)	Red maple	New Brunswick	Light or moderate defoliation in some areas of eastern New Brunswick. Populations lower than in 1984.
Lichens *Xanthoria* and *Hypogymnia physoides*	Conifers Hardwoods	New Brunswick Nova Scotia	Common near cement plant and lime works at Havelock, Westmorland Co., N.B., and near the cement plant at Brookfield, Colchester Co., N.S., covering stems and branches of many tree species, apparently not causing damage.
Maple leafroller *Sparganothis acerivorana* MacK.	Red maple Sugar maple	Maritime provinces	Moderate or severe damage on red maple in Prince Edward Island, light in New Brunswick and Nova Scotia.
Maple tar spot *Rhytisma acerinum* (Pers. ex St. Amans) Fr.	Red maple Sugar maple	Nova Scotia Prince Edward Island	Common in many areas.
Mite *Oligonychus milleri* (McG.)	Jack pine	New Brunswick	Associated with varying levels (often severe) of foliage discoloration in numerous plantations in the southern part of the province. Although egg populations were extremely high in some areas, other factors might have contributed to the condition. Another mite, *Setoptus jonesi* (Keifer), was also present in much smaller numbers in some plantations.
Mountain-ash sawfly *Pristiphora geniculata* (Htg.)	Mountain-ash	Maritime provinces	Various levels of defoliation throughout the region.
Needle blight *Rhabdocline* sp.	Douglas-fir	Nova Scotia	Severe browning of numerous trees at West Leicester, Cumberland Co.
Needle casts *Lirula nervata* (Darker) Darker	Balsam fir	New Brunswick Nova Scotia	Found at varying levels of intensity at a few locations in natural forests in New Brunswick and in Christmas tree areas and natural forests in Nova Scotia.
Phaeocryptopus gaeumannii (Rohde) Petr.	Douglas-fir	Nova Scotia	Severe browning of numerous trees at West Leicester, Cumberland Co.
Needle rusts *Melampsora abieti-capraearum* Tub. *Milesina* sp. *Pucciniastrum epilobii* Otth *P. goeppertianum* (Kühn.) Kleb. *Uredinopsis* sp.	Balsam fir	Maritime provinces	Widespread but generally at low levels of infection, rarely exceeding 5% of the needles affected.
Melampsora sp.	Hemlock	Nova Scotia	Found at three locations at very low levels; in one place it, or a closely related species, affected 10% of the cones.
	Tamarack	Prince Edward Island	Infected 10% of needles at one location in western P.E.I.
Coleosporium asterum (Diet.) Syd. *C. viburni* Arth.	Pine	Maritime provinces	*Coleosporium asterum* caused light infection on red pine throughout the region and occurred on jack pine. *Coleosporium viburni*, in association with the former in some

Insect, Disease, or Damage	Host(s)	Location	Remarks
Needle rusts, cont'd			places, caused severe or moderate infection on jack pine in numerous plantations in New Brunswick. As much as 80% of needles affected in some plantations. Repeated severe defoliation in central and southern New Brunswick resulted in stressed trees in these areas.
Chrysomyxa ledi (Alb. & Schw.) de By *C. ledicola* Lagh.	Spruce	Maritime provinces	Varying infection levels throughout the region. *Chrysomyxa ledicola* caused severe needle discoloration of black spruce in bogs in widespread areas in southwestern Nova Scotia.
Northern pitch twig moth *Petrova albicapitana* (Bsk.)	Jack pine	New Brunswick Nova Scotia	Present in a few jack pine stands and plantations in New Brunswick at low populations and at varying levels of intensity at locations in Lunenburg, Cumberland, and Colchester counties, N.S.
Oak leafshredder *Croesia semipurpurana* (Kft.) Oak olethreutid leafroller *Pseudexentera cressoniana* (Clem.)	Red oak	New Brunswick Nova Scotia	Decline of populations reported in previous years continued in 1985. Defoliation was moderate or severe in patches in southern New Brunswick but generally light elsewhere in this province and in western Nova Scotia. Trees in many areas of repeated defoliation are in poor shape with twig and branch mortality prevalent.
Orangehumped mapleworm *Symmerista leucitys* Francl.	Beech Sugar maple	Nova Scotia	Populations drastically reduced from 1984 levels. Moderate and light defoliation occurred only in the lower crowns of beech and sugar maple trees in a few stands in Halifax Co.
Pine leaf adelgid *Pineus pinifoliae* (Fitch)	Red spruce White pine	Nova Scotia	Common throughout Nova Scotia on red spruce and white pine at different levels of intensity
Porcupine damage	Conifers	New Brunswick Nova Scotia	Common throughout New Brunswick and Nova Scotia.
Saddled prominent *Heterocampa guttivitta* (Wlk.)	Beech Sugar maple	Nova Scotia Prince Edward Island	Present in low numbers in scattered areas in Nova Scotia. Found on beech in Kings Co., P.E.I.
Salt damage	Conifers	New Brunswick Nova Scotia	Foliage reddening, mainly of white pine and red pine, on roadside trees throughout New Brunswick and Nova Scotia.
Satin moth *Leucoma salicis* (L.)	Balsam poplar Carolina poplar Lombardy poplar Silver poplar	Maritime provinces	Moderate and severe defoliation on ornamental trees in scattered areas throughout the region.
Scale insects *Eriococcoidae*	Beech	New Brunswick	Trees in about 4 ha in Gloucester Co. supported high populations and were often black from a

Insect, Disease, or Damage	Host(s)	Location	Remarks
Scale insects, cont'd			cover of sooty mold growing on the honeydew secreted by these insects.
Seedling-debarking weevil *Hylobius congener* D.T.	Conifers	Nova Scotia New Brunswick	Present in 3 of 8 plantations examined in New Brunswick and 20 of 24 plantations in Nova Scotia, causing seedling mortality in newly established plantations. As much as 77% of seedlings attacked (70% mortality) in Nova Scotia and 16% attacked (13% mortality) in New Brunswick.
Spring cankerworm *Paleacrita vernata* (Peck)	Hardwoods	Nova Scotia	Caused varying amounts of defoliation, in association with other insects, in six areas in the northern part of western Nova Scotia.
Spruce coneworm *Dioryctria reniculelloides* Mut. & Mun.	Spruce	Maritime provinces	Populations continue to be generally low.
Spruce gall adelgid *Adelges lariciatus* (Patch)	Tamarack	New Brunswick	On young seed orchard trees.
Spruce spider mites *Oligonychus ununguis* (Jac.)	Spruce Other conifers	New Brunswick Nova Scotia	Varying levels of foliage discoloration, mainly on oranmental trees and in a few Christmas tree stands in many areas.
Striped alder sawfly *Hemichroa crocea* (Geoff.)	Alder	Maritime provinces	Populations in Prince Edward Island and New Brunswick collapsed and no defoliation occurred in the region.
Tip blight *Delphinella balsameae* (Waterman) E. Müll.	Balsam fir	New Brunswick Nova Scotia	Common in the Fundy National Park area, Albert Co., with up to 75% of current shoots affected on scattered trees. Present also in Carleton, York, and Kings counties, N.B., and found on one tree at Sutherlands Lake, Pictou Co., N.S.
Tree mortality	Balsam fir Spruce	Maritime provinces	A survey of 96 merchantable fir–spruce stands showed that recent tree mortality is 13% in New Brunswick, 22% in Nova Scotia, and 20% in Prince Edward Island.
Wax filament scale *Xylococculus betulae* (Perg.)	Willow	New Brunswick	Found on willow at Calder Head, Charlotte Co. This organism is commonly found on birch and beech; willow is a new host record for the region.
Whitemarked tussock moth *Orgyia leucostigma leucostigma* (J.E. Smith)	Conifers Hardwoods	Nova Scotia New Brunswick	After years of very low populations, the insect is becoming common in mainland Nova Scotia and in southern New Brunswick, probably indicating the start of a new outbreak.
White pine needle blight	White pine	Maritime provinces	At scattered locations at various levels of intensity in southern New Brunswick, much of western Nova Scotia, and at one

Insect, Disease, or Damage	Host(s)	Location	Remarks
White pine needle blight, cont'd			location in Inverness Co. on Cape Breton Island. Not observed in Prince Edward Island.
White pine weevil *Pissodes strobi* (Peck)	Jack pine Norway spruce Red spruce White pine White spruce	Maritime provinces	Continued to cause leader mortality throughout much of the region; white pine the host most often affected.
Willow blight *Venturia saliciperda* Nuesch	Willow	Maritime provinces	Severe on ornamentals in Queens and St. John counties, N.B.; present at various levels of intensity in Colchester, Hants, Kings, Annapolis, and Digby counties, N.S.; not found in Prince Edward Island.
Willow flea weevil *Rhynchaenus rufipes* (LeC.)	Poplar Willow	Maritime provinces	Severe and moderate browning of ornamental willows throughout most of the region.
Winter drying	Balsam fir Black spruce Red pine Scots pine White pine	Nova Scotia Prince Edward Island	Moderate and severe foliage discoloration on various species throughout Prince Edward Island and a few locations in Nova Scotia.
Winter moth *Operophtera brumata* (L.)	Hardwoods	Nova Scotia	Found mostly mixed with fall cankerworm, causing various levels of defoliation.
Yellowheaded spruce sawfly *Pikonema alaskensis* (Roh.)	Black spruce Red spruce White spruce	Maritime provinces	Severe defoliation in a 1.5-ha black spruce plantation at Dromone, Queens Co., P.E.I., where more than 7% of trees were dead from repeated defoliation in recent years. Light and moderate defoliation in plantations elsewhere in this county. A few insects collected in New Brunswick and Nova Scotia but no defoliation observed.
Yellow underwing (a European false underwing) *Noctua pronuba* L.	Undetermined	Nova Scotia	This newly imported species was found at Tangier, N.S. Not found at the locations in Halifax and Hants counties where it occurred previously. The implication of this newly introduced species to forestry is not yet known.
Yellow witches'-broom *Melampsorella caryophyllacearum* Schroet.	Balsam fir	New Brunswick Nova Scotia	Becoming a serious problem in Christmas tree plantations where site preparation encourages the growth of chickweed, the alternate host.

Other Insects, Diseases, and Damage

Quebec Region

Insect, Disease, or Damage	Host(s)	Location	Remarks
Aspen serpentine leafminer *Phyllocnistis populiella* (Cham.)	Trembling aspen	Gaspé Peninsula	Affected area (199 000 ha) similar to 1984, but intensity is reduced. Severe damage over 11 750 ha in 1985 compared with 67 250 ha in 1984.
Aspen twoleaftier *Enargia decolor* (Wlk.)	Trembling aspen	Témiscamingue Census Division	On hwys 382 and 101; more than 80% defoliation over 3 km and 1 km, respectively, near Belleterre and Letang.
Beech bark disease *Nectria coccinea* (Pers. ex Fr.) var. *faginata* Lohm., Wats. & Ayres	Beech	Portneuf, St-Maurice, and Arthabaska census divisions	On the north shore of the St. Lawrence, disease was found at aux Sables and à la Perchaude lakes; this represents about a 60-km westerly extension in the 1980 disease distribution. On the south shore of the St. Lawrence, a westerly advance of about 75 km was recorded, the disease having been found near Victoriaville.
Birch skeletonizer *Bucculatrix canadensisella* Cham.	White birch	West Lac-Saint-Jean Census Division	Appreciable decline in populations from 1984 levels: several areas of severe defoliation persist near Ste-Hedwidge-de-Roberval and 30 km north of Girardville.
		Outaouais region, La Vérendrye Reserve, and East Lac-Saint-Jean Census Division	General reduction in damage: defoliation abated from moderate to light.
Bruce spanworm *Operophtera bruceata* (Hulst)	Sugar maple Trembling aspen Beech	Western Quebec	Population continued to increase; patches of defoliation as large as 160 ha occurred.
Chainspotted geometer *Cingilia catenaria* (Drury)	Tamarack	Drummond Census Division	In a peet bog northwest of Kingsey-Falls: light to moderate defoliation over 8 ha and severe defoliation over 1 ha.
Common June beetle *Phyllophaga* sp.	Black spruce	Mistassini Census Division	3% of trees affected at root level in a 40 000-plant seed orchard established in 1985.
	Balsam fir	Beauce Census Division	Insect larvae killed a bed of young Christmas trees over about 1 ha in Ste-Clothilde.
Dieback	Eastern hemlock	Témiscamingue Census Division	Observed previously in the Outaouais region in 1982, this phenomenon has now reached the southern Abitibi–Témiscamingue region. Eastern hemlock stands had 40–80% of their crowns affected.
Dutch elm disease *Ceratocystis ulmi* (Buis.) C. Moreau	White elm	West Lac-Saint-Jean Census Division	Mortality observed along the à l'Ours River in St-Félicien. Moderate damage to young trees.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Elm lace bug *Corythucha ulmi* O. & D.	White elm	Gatineau Census Division	The area of infestation reported last year on Hwy 105 south of Wakefield still persists and has extended northward this year to Lascelles.
		Papineau Census Division	New 1-ha infestation in Plaisance, where foliage was more than 90% affected.
Fall cankerworm *Alsophila pometaria* (Harr.)	Sugar maple Red maple	South–central Quebec	Light defoliation in St-Henri, St-Gregoire, St-Zephirin, St-Vallier, Ste-Marguerite, Ste-Claire, and St-Anselme. Probable increase in populations in the Trois-Rivieres area in 1986.
Fall webworm *Hyphantria cunea* (Drury)	White ash	Huntingdon Census Division	On Hwy 132, concentration of 80 tents over 0.1 km.
		Terrebonne Census Division	180 trees observed, average of four tents per tree; on Hwy 148 between St-Eustache and Allumettes Island; populations declining.
Hail damage	Jack pine	Abitibi Census Division	About 55 ha affected 22 km west of Beattyville.
	Trembling aspen	Témiscamingue Census Division	On July 19, this weather occurrence caused a 25% denuding of tree crowns over 650 ha between Rouyn and Beaudry.
Ice storm damage	Sugar maple Red maple Trembling aspen	Nicolet, Mégantic, Lotbiniere, and Beauce census divisions	Between the towns of Bécancour and Ste-Marie, ice storms Feb. 23 and 24, 1985 caused light damage in several maple stands. The affected area measures about 95 km from west to east and 25 km from north to south.
Ink spot *Ciborinia whetzelii* (Seaver) Seaver	Trembling aspen	Saguenay–Lac-Saint-Jean and Abitibi–Témiscamingue	General reduction in damage in 1985, although many stands show 6–25% of foliage affected in the regions mentioned.
Jack pine sawfly or blackheaded jack pine sawfly *Neodiprion pratti banksianae* Roh.	Jack pine	Pontiac Census Division	Heavy insect populations in tree crowns along about 15 km between Campbell's Bay and Fort-Coulonge; moderate defoliation over 87 ha in Vinton and over 27 ha in Fort-Coulonge.
		St-Maurice and Champlain census divisions	Light damage in the Chapeau-de-Paille area and 5 km northeast of Lac Normand; continued presence of the insect along Hwy 40 between Champlain and Cap-de-la-Madeleine, with light defoliation.
Larch casebearer *Coleophora laricella* (Hbn.)	Tamarack	Brome Census Division	Moderate to severe defoliation for a 2nd yr in a 3-ha pure stand on Gale Mountain.
		Shefford Census Division	Along Hwy 243; more than 50% defoliation over about 1 km near Lawrenceville.
		Frontenac and Lotbinière census divisions	Progressively visible and frequent damage; south of St-François

Insect, Disease, or Damage	Host(s)	Location	Remarks
Larch casebearer, cont'd			and Aylmer lakes; in La Guadeloupe and Ste-Agathe; foliage generally affected 25–50%.
Larch needleworm or larch budmoth *Zeiraphera improbana* (Wlk.)	Tamarack	New Quebec territory	Severe infestation present for 3 or more yr in many isolated stands west and south of Lake Pau, north of the 54th parallel. Other isolated infestations near Lake Renault (Abitibi), Lake Eddy, Manic-Cinq and the Saguenay River (Saguenay), and Mont-Louis Lake (Gaspé-Ouest)
Large aspen tortrix *Choristoneura conflictana* (Wlk.)	Trembling aspen	Matane Census Division	6 km east of Capucins, a near-pure stand suffered moderate defoliation over about 100 ha.
		Kamouraska and Rivière-du-Loup Census Divisions	Increase in populations throughout the area; insect encountered more frequently this year.
		West Lac-Saint-Jean Census Division	Generalized presence around Lac-Saint-Jean, with pockets of light defoliation between Ste-Hedwidge-de-Roberval and Roberval.
		Saguenay Census Division	Total defoliation over 12 ha, 1 km west of Lake Moffatt; refoliation observed July 4.
Leaf rusts *Pucciniastrum sparsum* (Wint.) E. Fisch. and *Chrysomyxa ledicola* Lagh.	White spruce	Throughout Quebec	Final identification of this organism harvested in 1984, when this disease was particularly abundant.
Maple leafcutter *Paraclemensia acerifoliella* (Fitch)	Sugar maple	St-Hyacinthe Census Division	All trees in a 10-ha area on Rougemont Mountain affected for a 2nd consecutive year: light to moderate defoliation.
Needle casts *Lophodermium nitens* Darker *L. pinastri* (Schrad. ex Fr.) Chev.	Red pine White pine	Berthier Census Division	In the Berthierville provincial nursery, nearly 90% of the 3.6 million seedlings of these species had their foliage slightly affected.
Needle rust *Chrysomyxa ledicola* Lagh.	White spruce	Throughout Quebec	100% of the annual shoots of all trees in a plantation in St-Séverin-de-Beauce were affected by this rust.
Orangehumped mapleworm *Symmerista leucitys* Franc.	Sugar maple Yellow birch Beech	Portneuf and Beauce census divisions	Total defoliation over about 30 ha in St-Basile and East-Broughton. Several other cases noted in Beauce and in the Eastern Townships.
Poplar leafminer *Lyonetia* sp.	Trembling aspen Balsam fir	North shore of the St. Lawrence River	Found north of Baie-Comeau together with the aspen serpentine leafminer. Present on 36 350 ha; balsam fir in particular is attacked when populations are high.
Redheaded pine sawfly *Neodiprion lecontei* (Fitch)	Red pine	Pontiac Census Division	Moderate defoliation of a plantation of 280 pines near Shawville, and severe defoliation of a pine hedge at Lake Cayamant.

Insect, Disease, or Damage	**Host(s)**	**Location**	**Remarks**
Redheaded pine sawfly, cont'd	Jack pine	Pontiac Census Division	Moderate defoliation of a young plantation of 10 000 pines on Allumettes Island.
Red pine sawfly *Neodiprion nanulus nanulus* Schedl	Red pine	Huntingdon Census Division	Light to moderate defoliation in St-Antoine-Abbé, in the pitch pine ecological reserve: an average of four colonies per tree over more than 80% of trees observed; only one pitch pine affected.
Root rot *Cylindrocladium floridanum* Sobers & Seymour	Spruce	Central Quebec	In the provincial nurseries of Duchesnay (Portneuf), Berthierville (Berthier) Normandin (West Lac-Saint-Jean), St-Luce (Rimouski), and Grandes-Piles (Champlain). Damage observed at the end of summer affected as much as 20% of stems in certain production blocks.
Spruce budmoth *Zeiraphera canadensis* Mut. and Free.	White spruce	Gaspé Peninsula–Bas-Saint-Laurent	Insect found in 136 plantations, 7 of which suffered severe damage. These were located in Caplan, St-Alexis-de-Matapédia, and St-François-D'Assise (Bonaventure), Price (Matane), Lots-Renverses (Témiscouata), St-Narcisses-de-Rimouski, and Trinité-des-Monts (Rimouski).
Spruce spider mite *Oligonychus ununguis* (Jac.)	Tamarack	Bonaventure Census Division	70 km north of Caplan, in a plantation of various larch species established at irregular intervals since 1973: drastic and general yellowing of the majority of an estimated 1.3 million plants over a 600-ha area.
Swaine jack pine sawfly *Neodiprion swainei* Midd.	Jack pine	North–central Quebec	Light damage over 22 000 ha. A single area of moderate infestation covering 625 ha near Lac Charland (Berthier Census Division)
Windfall	Eastern white pine Eastern hemlock Red oak Sugar maple	Gatineau Census Division	The affected area covers 47 ha; damage is spread along Hwy 105 north of Hull.
Whitespotted sawyer *Monochamus scutellatus* (Say)	Jack pine	West Lac-Saint-Jean Census Division	100 km northwest of Normandin, large populations of adult insects invaded a mature stand covering several hectares; tree mortality was reported over 2 ha. Larvae developed in a nearby black spruce stand, where mortality due to spruce budworm had been reported recently.

Other Insects, Diseases, and Damage

Ontario Region

Insect, Disease, or Damage	Host(s)	Location*	Remarks
Alder flea beetle *Altica ambiens alni* Harrison	Alder	Northern region	Found at numerous areas on fringe and shoreline trees.
American aspen beetle *Gonioctena americana* (Schaeff.)	Trembling aspen	Ignace District	Immature trees sustained 75% defoliation in the Gulliver River area on 0.5 ha.
		Nipigon and Wawa districts	Regeneration was severely defoliated at the Tyrol Lake Management Unit and at White Lake Prov. Park.
		Hearst District	Small pocket of moderate damage in Dowsley Township.
Anthracnose *Apiognomonia quercina* (Kleb.) Höhnel and *Tubakia dryina* (Sacc.) B. Sutton	White oak Bur oak	Huronia District	Medium to heavy infections of single trees or small groups of trees with accompanying defoliation of 30–75% was recorded in the townships of Baxter, Matchedash, Medonte, and Orillia.
	Red oak	Southwestern region	Defoliation levels of 10% or less recorded in Aylmer, Simcoe, and Chatham districts.
	Shagbark hickory	Eastern region	Foliar damage of 50–100% reported in Napanee and Brockville districts.
Gnomonia leptostyla (Fr.) Ces. & de Not.	Butternut Black walnut	Lindsay and Minden districts	Reported causing premature leaf drop.
		Cambridge and Simcoe districts	Moderate to severe defoliation of fringe and roadside trees was observed.
Aureobasidium apocryptum (Ell. & Ev.) and *Discula campestris* (Pass.) v. Arx	Sugar maple Red maple White elm	Espanola District	Small groups of white elm and sugar maple experienced foliar infections of 100% in Billings and Mills townships.
	Silver maple	Pembroke District	Similar infection levels on red and sugar maple occurred in Raglan Township. Lighter foliage damage was noted in other areas.
		Central region and Thunder Bay District	Light foliar damage was recorded in the Niagara District and city of Thunder Bay.
		Southwestern region	Light foliar damage was recorded in Simcoe, Wingham, Aylmer, and Chatham districts.
Armillaria root rot *Armillaria mellea* (Vahl ex Fr.) Kumm.	Pine Spruce Oak	Province-wide	Light mortality of 1–3% was recorded.
		Algonquin Park District	Mortality of 15–20% was reported in an experimental jack pine plantation in Stratton Township.
Aspen leafblotch miner *Phyllonorycter ontario* (Free.)	Trembling apsen	Northern, north–central, northwestern, and northeastern regions	Increasing populations, mostly noticeable in fringe and roadside trees, resulted in pockets of severe defoliation throughout northern Ontario.

*The districts are provincial administrative districts.

Insect, Disease, or Damage	**Host(s)**	**Location**	**Remarks**
Balsam fir sawfly *Neodiprion abietis* complex	Balsam fir White spruce Black spruce	Northwestern region	Heavy infestations, with defoliation ranging from 10 to 75%, occurred from the Manitoba border east to Zealand Township, Dryden District; from Minaki south through Kenora to Nestor Falls, Kenora District; and between Ear Falls and Pakwash Lake, Red Lake District.
		Algonquin region	About 1300 ha of infestation with defoliation of 25–75% was recorded in Pembroke, Bancroft, and Algonquin Park districts.
		Eastern region	Small clumps of balsam fir sustained 60–70% defoliation in the Carleton Place District.
Basswood looper *Erannis tiliaria tiliaria* (Harr.)	Deciduous species	Blind River and Sault Ste. Marie districts	About 1050 ha of sugar maple forest sustained 10% foliar damage.
Beech scale *Cryptococcus fagisuga* Lind.	Beech	Cambridge District	Low populations were identified in hardwood stands in Blenheim and Erin townships and at Bronte Creek Prov. Park.
Birch lace bug *Corythucha pallipes* Parsh.	White birch	Northwestern region	Heavily skeletonized clumps of mature trees occurred in Drayton Township, Sioux Lookout District, and at Rushing River Prov. Park, Kenora District.
Birch leafminer *Fenusa pusilla* (Lep.)	White birch Grey brich	Southern Ontario	Medium and heavy infestations were reported on natural occurring trees at locations in Huronia, Lindsay, Bracebridge, Parry Sound, and Cornwall districts.Many urban areas had high populations.
		Northern Ontario	Heaviest damage to forest trees occurred in the Latchford–Cobalt area, Temagami District and Charleton–South Y–Long Lake area, Kirkland Lake District, where 75% defoliation occurred. Numerous other areas of damage were reported on both ornamentals and forest trees.
Birch sawfly *Arge pectoralis* (Leach)	White birch	Southern and northeastern Ontario	High numbers caused up to 100% defoliation in McKim Township, Sudbury District, and on occasional trees in Georgian Bay Township, Huronia District. Commonly found at low levels through the districts of Temagami, Kirkland Lake, Timmins, Gogama, and Chapleau. Single areas were affected in each of the Parry Sound and Algonquin Park districts.
Birch skeletonizer *Bucculatrix canadensisella* Cham.	White birch	Province-wide	Infestations collapsed in most areas.
		Algonquin Park District	A total of 63 ha of moderate to severe defoliation remains along the north shore of Lake La Muir.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Birch skeletonizer, cont'd			Bishop Township, and on the north arm of Opeongo Lake, Bower Township.
Black army cutworm *Actebia fennica* (Tausch.)	Black spruce	Township 239, Hearst District	Infestation collapsed.
	Jack pine	Hill Township, Chapleau District	About 4.5% of recently planted trees were destroyed on a 1984 prescribed burn site.
	Jack pine Red pine	Londonderry Township, Gogama District and Piche Township, Blind River District	Low amount of damage occurred to plantation trees on prescribed burn sites.
Black cutworm *Agrotis ipsilon* (Hufn.)	Black spruce	Hearst District	Caused the destruction of about 50 000 greenhouse seedlings. The insect was effectively controlled with the insecticide Lorsdan.
Bruce spanworm *Operophtera bruceata* (Hulst)	Sugar maple Red maple Beech Trembling aspen	Northeastern region	Increased populations for 2nd consecutive year. Largest infestations occurred on St. Joseph and Campement d'Ours islands, Sault Ste. Marie District, where moderate to severe defoliation covered 22 000 ha. About 6000 ha of moderate to severe defoliation in scattered pockets on Manitoulin Island, Espanola District.
		Algonquin region	Heavy defoliation encountered in Sebastopol Township, Pembroke District, Herschel and Faraday townships, Bancroft District, and several townships in the Minden District.
		Huronia and Owen Sound districts	Small pockets of moderate to severe defoliation scattered through both districts.
Canker *Caliciopsis pinea* Pk.	White pine	Owen Sound District	Found in association with mortality of young trees in a plantation in Keppel Township.
Cedar leafminers *Argyresthia thuiella* (Pack.) with *A. canadensis* Free., *A. aureoargentella* Brower, *Pulicalvaria thujaella* (Kft.)	Eastern white cedar	Espanola District, northeastern region	About 2720 ha of moderate to severe defoliation recurred on the south sides of Manitoulin and Cockburn islands.
		Owen Sound District, southwestern region	Moderate to severe damage persisted on about 1400 ha on the west side of the Bruce Peninsula. Low populations occurred throughout the region.
		Central region	Low numbers at several points in the Cambridge, Maple, and Huronia districts.
Cooley spruce gall adelgid *Adelges cooleyi* (Gill).	Douglas fir	Aylmer District	High numbers caused trace to low levels of foliar damage.
Diplodia canker *Diplodia juglandis* Fr.	Black walnut	Central region	The fungus was found in association with heavy twig dieback in a 1-ha plantation in Maple District.
Drought damage	Jack pine	Chapleau District	Seedling mortality exceeded 90% at the Chapleau Forest Tree nursery.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Drought damage, cont'd	Jack pine	Bancroft District	Partial and whole seedling mortality noted on 80% of all 4-yr-old stock examined in a single plantation.
Dutch elm disease *Ceratocystis ulmi* (Buism.) C. Moreau	White elm	Southwestern region	Infection levels of young trees ranged from 2 to 8%.
		Pembroke District	Observation of semimature trees disclosed moderate infection levels.
Early birch leaf edgeminer *Messa nana* (Klug)	White birch	Sudbury District	Light infestations were recorded in the city of Sudbury area, a new FIDS distribution point.
Eastern blackheaded budworm *Acleris variana* (Fern.)	Spruce Balsam fir	Northern region	Light defoliation occurred in Seaton and Fauquier townships, Kapuskasing District; in Sheldon, Mowbray, and Colquhoun townships, Cochrane District; and in a white spruce seed production area in Reeves Township, Chapleau District.
		North–central region	Low numbers on a white spruce seed production area at Barbara Lake, Terrace Bay District.
Eastern pine shoot borer *Eucosma gloriola* Heinr.	Jack pine	Northern Ontario	Generally low and declining populations. Most serious damage occurred in Skead Township, Kirkland Lake District, where 14% of 2.2-m trees had leader damage.
Eastern tent caterpillar *Malacosoma americanum* (F.)	Deciduous species	Southern Ontario and northeastern region	Unusually heavy infestations occurred in most of southern Ontario and in the North Bay, Sudbury, and Espanola districts.
European alder leafminer *Fenusa dohrnii* (Tisch.)	European alder	Lindsay District	Heavily affected 1- to 2-m trees in one compartment of the Orono Forest Station.
	Alder	Chapleau District	Roadside alder suffered 100% defoliation, south of town of Chapleau.
European pine sawfly *Neodiprion sertifer* (Geoff.)	Red pine Scots pine	Southern Ontario	Increased populations occurred in many areas.
European pine shoot moth *Rhyacionia buoliana* (D. & S.)	Red pine	Cambridge District	Single occurrence of damage affecting 70% of trees in plantation.
		Southwestern region	Found in significant numbers at several locations.
Eutypella canker *Eutypella parasitica* Davidson & Lorenz	Sugar maple	Bracebridge District	Several cankered trees in a 5-ha stand in Strong Township exhibited 30% top decline.
Fall cankerworm *Alsophila pometaria* (Harr.)	Deciduous species	Northwestern region	Severe defoliation (up to 100%) occurred in Manitoba maple in Sioux Lookout whereas populations declined in Kenora and Dryden where scattered trees were moderately defoliated.
		North–central region	Infestations increased in the city of Thunder Bay with defoliation ranging up to 100%.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Fall cankerworm, cont'd		Central region	Average of 80% defoliation of hedgerow trees at a location in Tecumseh Township, Huronia District.
Fall webworm *Hyphantria cunea* (Drury)	Deciduous species	Northern Ontario	Populations were generally low. Locations of significant damage occurred south of Minaki, Kenora District, in Menary Township, Fort Frances District, and in the North Bay area.
		Eastern region	84 ha heavily infested.
		Algonquin region	Small areas of severe damage occurred in the Parry Sound, Bracebridge, and Minden districts.
		Central region	High populations were evident in the north portions of Huronia and Lindsay districts and along the Niagara Parkway, Niagara District.
		Southwestern region	Common throughout the region.
Fire blight *Erwinia amylovora* (Burr.) Winslow et al.	Mountain-ash	Simcoe District	Single occurrence of moderate crown damage on an ornamental, Woodhouse Township.
Flat leaftier *Psilocorsis reflexella* Clem.	Red oak Trembling aspen	Algonquin region and Lindsay District	Small pockets of severe browning caused by heavy defoliation.
Fletcher scale *Parthenolecanium fletcheri* (Ckll.)	Eastern white cedar	Chapleau District	Moderate numbers in a 25-ha stand in Warren Township.
Fomes root rot *Heterobasidion annosum* (Fr.) Bres.	Red pine	Eastern and central region	Low incidence of mortality Clarence Township, Cornwall District, and plantation trees in Lindsay District, new infection centers were located in the Limerick Forest, Brockville District, as well as Tosorontio Township, Huronia District.
Frost damage	Balsam fir White spruce Black spruce	Northwestern, north–central, northeastern regions	Trace to low levels of foliar damage at varying incidence at numerous locations.
Frost heaving	Black spruce White spruce	Thunder Bay District	Losses approached 11 million seedlings in provincial and private nurseries.
Globose gall rust *Gymnosporangium globosum* Farl.	Red cedar Hawthorn	Bancroft District	Hawthorn was severely affected while red cedar experienced light infections.
Gray willow leaf beetle *Pyrrhalta decora decora* (Say)	Willow	North–central region	Widespread, heavy infestations of this insect occurred during the early summer.
		Northwestern region	High numbers and severe damage occurred in the large willow swamps.
		Northern region	Scattered defoliation sometimes reaching 100% of roadside bushes.
Hail damage	Hardwoods and conifers	Atikokan District	Several areas of severe foliar damage totalling more than 14 300 ha.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Horned oak gall wasp *Callirhytis cornigera* (O. S.)	Pin oak	Niagara District	Branch and whole tree mortality at several locations.
Hypoxylon canker *Hypoxylon mammatum* (Wahl.) J.H. Miller	Trembling aspen	Geraldton District	Stem damage of 2% was recorded in a 10-ha area in Ashmore Township.
		Algonquin Park District	Stem cankers were found affecting 40% of natural regeneration in a 2-ha area in Lyell Township.
		Minden District	In Somerville Township, evaluation disclosed that 6% of the trees were cankered.
Ink spot *Ciborinia whetzelii* (Seaver) Seaver	Trembling aspen	Kirkland Lake and Timmins districts	Small pockets (less than 10 ha) of medium to heavy infection were noted in several areas with corresponding foliar damage ranging from 10 to 70%.
		Sault Ste. Marie, Terrace Bay, and Gogama districts	Moderate to severe damage was recorded in Hoffnan, Lahontan, Cartier, and Cabot townships.
		Province-wide	Areas of light damage were commonly observed.
Introduced pine sawfly *Diprion similis* (Htg.)	White pine Red pine Scots pine	Southwestern region	Intensified surveys revealed presence of this sawfly in most white pine plantations in the region. Heaviest damage occurred in the Owen Sound District in Amabel and Saugeen townships, where defoliation ranged as high as 100% and the latter location had 2% mortality.
		Carleton Place District	Defoliation ranging from 40 to 70% was recorded on roadside trees in the Kemptville–Burritts Rapids area.
		Remainder of province	Low, but increased numbers in several areas.
Jack pine resin midge *Cecidomyia resinicola* (O.S.)	Jack pine	Timmins, Temagami, Kirkland Lake, and Chapleau districts	Caused conspicuous damage to new shoots in several plantations.
Jack pine sawflies *Neodiprion maurus* Roh.	Jack pine	Geraldton District	Feeding in conjunction with *N. nanulus nanulus* Schedl caused 100% loss of old foliage on scattered semimature trees along Hwy 584 near Geraldton.
N. pratti banksianae Roh.	Jack pine	Chapleau and Gogama districts	Heavy infestations were located in fringe and ornamental trees in Jack, Nobel, and Dublin townships, Gogama District; ornamental trees experienced 60% defoliation in the town of Chapleau, Chapleau District.
N. pratti paradoxicus Ross	Jack pine	Algonquin region	Severe defoliation occurred to about 250 ha of host scattered through six townships in the Pembroke District; elsewhere low numbers observed.
		Carleton Place, Brockville, and Niagara districts	Plantations in Elizabethtown Township, Brockville District, and Rideau Township, Carleton Place District, were sprayed by OMNR personnel to control heavy infestations; elsewhere moderate damage occurred to occasional ornamentals.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Jack pine tip beetle *Conophthorus banksianae* McP.	Jack pine	Northern and northeastern region	Occasionally found at low numbers.
Larch casebearer *Coleophora laricella* (Hbn.)	Tamarack European larch	Southern Ontario	Several areas of medium and heavy infestations on both hosts.
		Northern Ontario	Moderate to severe defoliation of tamarack in Bonfield Township, North Bay District, and in Carnarvon Township, Espanola District.
Larch sawfly *Pristiphora erichsonii* (Htg.)	Tamarack	Province-wide and Atikokan and Thunder Bay districts	Low and declining populations; exceptions found in Neebing and Upsala townships, Thunder Bay District, and near Lerome Lake and the town of Atikokan, Atikokan District, where moderate to severe damage was reported.
Large aspen tortrix *Choristoneura conflictana* (Wlk.)	Trembling aspen	Thunder Bay District	An area of moderate to severe defoliation of 20 900 ha occurred along the Ontario–Minnesota border.
		Northeastern region	Moderate to severe defoliation, about 3400 ha was mapped on St. Joseph Island, Saulte Ste. Marie District, and within 3200 ha west of Espanola.
Leaf blight *Linospora tetraspora* G.E. Thomp.	Balsam poplar	Northern region	Common at high foliar damage levels (75%) across the Kapuskasing, Hearst, and western portion of the Cochrane districts.
		Kapuskasing, Cochrane, and Hearst districts	Severe browning and premature leaf fall were observed in stands throughout the Hearst and Kapuskasing districts and in the western part of the Cochrane District.
Leaf blotch *Guignardia aesculi* (Pk.) V.B. Stewart	Horse-chestnut	Southwestern and central regions	Foliar damage averaged 25–75% on primarily ornamentals throughout most of the host range.
Leaf rust *Melampsora epitea* Thüm.	Willow	Chapleau District	Commonly found at low infection levels on 30% of trees examined.
Leaf spot *Cercospora microspora* Sacc.	Basswood	Cambridge District	Small trees experienced moderate infections in Flamboro Township.
Marssonina brunnea (Ell. & Ev.) Sacc.	Trembling aspen	North-central region	Moderate to severe foliar damage was recorded at numerous scattered points, primarily across the southern portions.
M. juglandis (Lib.) Magn.	Walnut Butternut	Lindsay, Minden, Cambridge, and Simcoe districts	Moderate to severe levels of foliar damage, accompanied by premature leaf drop was recorded on open grown and woodlot trees.
M. populi (Lib.) Magn.	Balsam poplar	Algonquin and central regions	Foliar damage noted at high levels in small scattered pockets throughout much of the range of host.
Mycosphaerella effigurata (Schw.) House	Ashes	Central region	Low levels of foliar damage (10–20%) common on regeneration.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Leaf spot, cont'd		Southwestern region	Single occurrence of severe foliar damage to small stand.
M. populi (Lib.)	Balsam poplar	Lindsay, Minden, Bracebridge, and Parry Sound districts	Defoliation average 50–90% throughout the districts.
M. populicola G.E. Thomp.	Balsam poplar	Geraldton, Wawa, Chapleau, and Gogama districts	Heavy foliar damage recorded at numerous locations.
Phyllosticta minima (Berk. & Curt.) Ell. & Ev.	Red maple Silver maple	Wingham and Simcoe districts	Low incidence and damage reported at several locations.
Tubakia dryina (Sacc.) B. Sutton	Bur oak	Algonquin region	Common in the southern parts of Pembroke and Bancroft districts.
Locust borer *Megacyllene robiniae* (Förster)	Black locust	Simcoe District	Larval stem damage rendered windbreak trees prone to windsnap.
Maple leafcutter *Paraclemensia acerifoliella* (Fitch)	Maple	Central region	Declining populations reported from the Halton Regional Forest, Cambridge District, and Beausoleil Island, Huronia District. A severe infestation covering 126 ha was observed in Belmont Township, Lindsay District.
		Algonquin region	Both distribution and population numbers declined with only two pockets of heavy infestation located in Laxton Township, Minden District; and Wilberforce Township, Pembroke District.
		Eastern region	At Murphy's Point Prov. Park the infestation increased from 20 ha in 1984 to 30 ha in 1985. A heavy infestation occurred in a 500-ha area near Marmora, Tweed District.
Maple leafroller *Cenopis acerivorana* Mack.	Red maple Sugar maple	Carleton Place District	Moderate defoliation in small 1-ha patches in several areas.
Maple trumpet skeletonizer *Epinotia aceriella* (Clem.)	Red maple Sugar maple	Eastern region	Reduced populations were evident throughout the region. Severe damage was located in Presqu'ile Prov. Park covering about 20 ha. Moderate to severe damage was also recorded in a 480-ha area near Marmora, Tweed District.
		Aylmer District	At John E. Pearce Prov. Park heavy defoliation occurred on about 5 ha.
		Northern and northeastern regions	Low populations scattered in small pockets over both regions.
Maple webworm *Tetralopha asperatella* (Clem.)	Sugar maple	Algonquin and central regions	Fringe trees showing light defoliation throughout both regions.
Mound ant *Formica* sp.	White pine White spruce	Huronia District	Small pockets of mortality in a single plantation.
Mountain-ash sawfly *Pristiphora geniculata* (Htg.)	Mountain-ash	North central region, northwestern region, northern region, northeastern region, and Lindsay District	Declining numbers revealed only light defoliation throughout most areas. Occasional roadside and ornamental trees displayed moderate to severe defoliation.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Needle blight *Kabatina thujae* (Schneider & Arx) Morelet	Juniper	Owen Sound District	Light to moderate damage was noted in Sullivan Township.
Needle cast *Davisomycella ampla* (Davis) Darker	Jack pine	Sudbury District	Moderate infections on mature trees in a 0.5-ha area were reported in Hart Township.
		Pembroke District	Foliar damage of 70% was recorded in part of a 7.0-ha plantation in Richards Township.
		Algonquin Park District	Foliar damage levels of up to 50% on 30% of 6-m roadside trees were noted in Maria Township.
		Province-wide	Reports of light damage were received from numerous locations.
Leptostroma sp.	Red pine	Huronia District	Seedlings in one entire compartment were destroyed and those in adjacent compartments also experienced some damage in the Midhurst Nursery, Vespra Township.
Lophodermium seditiosum Minter et al.	Jack pine	North Bay District	Single occurrence noted at low foliar damage levels.
Lophodermium sp.	White spruce	Terrace Bay District	Light infections were found on occasional trees in Pukaskwa Park.
	Red pine	Algonquin region	Evaluation revealed foliar damage levels of 20–90% affecting different age-classes in several plantations.
Needle rusts *Chrysomyxa ledi* (Alb. & Schw.) de By and *C. ledicola* Lagh.	White spruce Black spruce Colorado blue spruce	Northern and north–central regions	Light infections were common in most stands, representing major decreases from the previous year.
		Northwestern region	Increased foliar damage was reported. Evaluation disclosed infection levels up to 100% with corresponding foliage damage in some natural stands in the Red Lake, Sioux Lookout, and Fort Frances districts ranging from 25 to 100%. All of the blue spruce in a 2-ha block in the Dryden Nursery, Dryden District, were affected with an average defoliation of 30%.
Coleosporium asterum (Dietl.) Syd.	Red pine Jack pine	Hearst District	Foliar damage declined from 43 to 18% in the current survey of a plantation in Arnott Township.
		Pembroke Districts	Foliage infections of 3–15% were recorded in several plantations.
		Province-wide	Foliar damage of less than 5% was observed in numerous stands.
Meria laricis Vuill.	Larch	Cambridge District	New distribution point recorded in Beverley Township at trace incidence and damage levels.
Oak leafmining sawfly *Profenusa lucifex* (Ross)	Bur oak	Central region	Moderate foliar damage in Barrie, Huronia District, and in King Township, Maple District.
Oak leafshredder *Croesia semipurpurana* (Kft.)	Red oak	Central region	Light defoliation (up to 25%) was recorded in stands in Uxbridge Township, Maple District, and in Tiny Township, Huronia District.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Oak skeletonizer *Bucculatrix ainsliella* Murt.	Red oak	Central region	Foliar damage ranging from 50 to 90% occurred to red oak in the Cambridge and Ancaster–Dundas areas with lighter damage (up to 70%) occurring in the Brantford and Hamilton areas, Cambridge District, in the Richmond Hill area, Maple District, and in North Cayuga Township, Niagara District.
		Southwestern region	Low populations occurred in the Chatham and Simcoe districts.
Oak slug sawfly *Caliroa fasciata* (Nort.)	Red oak White oak Bur oak	Eastern region	Commonly found throughout work area causing severe defoliation.
Pine false webworm *Acantholyda erythrocephala* (L.)	Pines	Central region	Populations declined to low levels except in a 6-ha red pine plantation in Harvey Township, Lindsay District, where 60% of trees were severely defoliated.
		Algonquin region	Single red pine plantation with 40% defoliation in Stanhope Township, Minden District.
		Eastern region	Varying degrees of damage from several areas in the Brockville and Carleton Place districts.
		Southwestern region	Low populations on white pine in the Owen Sound District.
		Northern region	New distribution record was established on jack pine in Arnott Township, Hearst District.
Pine gall weevil *Podapion gallicola* Riley	Red pine	Algonquin region	New infestations located in Westmeath Township, Pembroke District, Burleigh Township, Bancroft District, and Edgar Township, Algonquin Park District.
		Central region	High numbers causing branch mortality in Haldimand Township, Lindsay District.
Pine needle sheathminer *Zelleria haimbachi* Bsk.	Jack pine	Central region	Moderate population levels in a small stand of jack pine in West Gwillimbury Township, Huronia District.
		Northern region, Blind River, Parry Sound, and Temagami districts	Low populations reported from various points.
Pine root collar weevil *Hylobius radicis* Buch.	Scots pine	Pembroke District	Killed 68 of 120 grafted experimental plantation trees in Buchanan Township.
Pine spittlebug *Aphrophora cribrata* (Wlk.)	Pine	Central region	High populations occurred on 8-m Scots pine in Glanbrook and Flamboro townships, Cambridge District.
		Algonquin and north–central regions	Low numbers were reported from numerous areas.
Poplar flea beetle *Altica populi* Brown	Balsam poplar	Espanola District	Numerous small stands throughout five townships suffered moderate to severe foliar damage.
		Pembroke and Bancroft districts	Total browning of entire crowns, commonly noted.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Poplar leafmining sawfly *Messa populifoliella* (Towns.)	Poplar	Eastern and northern regions	Conspicuous browning of eastern cottonwood in Seymour and Huntingdon townships, Tweed District, and of balsam poplar at points in Kapuskasing and Hearst districts.
Powdery mildew *Uncinula flexuosa* Pk.	Ohio buckeye	Cambridge district	Single incidence of trace foliar damage to several individuals.
Redheaded jack pine sawfly *Neodiprion rugifrons* Midd.	Jack pine	Northern region	Chapleau District contained 0.5-ha areas in Caouette and Gilliland townships with 25–80% defoliation; low numbers observed in the Cochrane and Hearst districts.
		Northwestern and north-central regions	Fort Frances and Terrace Bay districts both contained moderate defoliation of occasional roadside trees; low numbers reported elsewhere at various points.
Redheaded pine sawfly *Neodiprion lecontei* (Fitch)	Red pine Jack pine	Algonquin region	Moderate to high numbers of colonies caused high levels of defoliation at numerous plantations.
	Red pine	Central region	Widespread damage at high levels of defoliation noted throughout Huronia District.
	Red pine	Eastern region	Low numbers of colonies commonly sighted throughout, with a few heavy infestations recorded.
	Red pine	Northeastern region	Trace numbers of larvae reported in the Espanola and North Bay districts.
Red pine cone beetle *Conophthorus resinosae* Hopk.	Red pine	Temagami District	Heavy infestations recorded along the shores of Lake Temagami.
Red pine coneworm *Eucosma monitorana* Heinr.	Red pine	Simcoe	Single occurrence of high numbers damaging cones on mature plantation trees.
Red pine sawfly *Neodiprion nanulus nanulus* Schedl		North–central & northwestern regions	Light levels of defoliation occurred throughout both regions representing a general decline in population levels.
Red pine shoot moth *Dioryctria resinosella* Mut.	Red pine	Sudbury District	Single occurrence of moderate levels of shoot damage.
Root and butt rot *Ironotus tomentosus* (Fr.) Gilbertson	White spruce	Huronia District	The disease was associated with a pocket of dead and dying trees at C.F.B. Borden and with shelter-belt trees at the Midhurst Forest Tree Nursery.
Salt damage	White pine Red pine Eastern white cedar Juniper	Northeastern, north–central, Algonquin, and southwestern regions	Numerous areas of high levels of foliar damage including bud mortality of white pine in North Bay District.
Saratoga spittlebug *Aphrophora saratogensis* (Fitch)	Pine	Pembroke District	High numbers of nymphs on sweetfern, the alternate host, in previously infested areas in Hagarty and Fraser townships. A new area of infestation was detected in Ross Township.

Insect, Disease, or Damage	**Host(s)**	**Location**	**Remarks**
Saratoga spittlebug, cont'd	Sweetfern	Fort Frances District	Small numbers of nymphs collected. First record of the insect in the northwestern region.
Satin moth *Leucoma salicis* (L.)	Silver poplar Weeping willow	Eastern region	Increased populations occurred in the Napanee, Carleton Place, Brockville, and Cornwall districts.
Scorch	Sugar maple	Southwestern region	Numerous sugar maple stands suffered varying levels of foliar damage across the Owen Sound District.
	Yellow birch	Northeastern region	Several stands suffered foliar damage ranging from 30 to 50% in all ages and size-classes.
	Red maple Sugar maple Red pine	Algonquin region	Varying degrees of foliar damage to small groups of trees at widely scattered locations.
Shoot blight *Venturia macularis* (Fr.) E. Müll. & Arx	Trembling aspen	Northern region	High rates of infection 59–100% reported.
		Thunder Bay, Nipigon, and Atikokan districts	Moderate rates of infection commonly noted.
		Wawa, Blind River, Algonquin, and Pembroke districts	Occasionally recorded at varying or low infection rates.
Shorthorned oakworm *Anisota finlaysoni* Riotte	White oak Bur oak	Cambridge District	Low levels of defoliation reported on ornamentals and open-grown trees in three townships.
Small birch leafminer *Ectoedemia lindquisti* (Free.)	White birch	Huronia District	Reported at two locations in Georgian Bay Township.
Snout weevil *Otiorhynchus raucus* (F.)	Red pine White spruce	Central region	Unusually high populations caused about two-thirds mortality in a 1-ha area of recently planted red pine, Albion Township, Maple District.
Spearmarked black moth *Rheumaptera hastata* (L.)	White birch	Chapleau District	A declining trend since 1983 has continued with only trace levels evident in Peters Township.
Spiny ash sawfly *Eupareophora parca* (Cress.)	Black ash	Chapleau District	Severe damage along Hwy 101 in Hellyer Township.
Spiny elm caterpillar *Nymphalis antiopa* (L.)	Deciduous species	Northern and eastern regions	Heavy defoliation of individual trees occurred at several locations.
Spruce coneworm *Dioryctria reniculelloides* Mut. & Mun.	White spruce Black spruce	Cochrane, Hearst, and Kapuskasing districts	Recorded occasionally damaging foliage at low levels.
Spruce gall adelgids *Adelges abietis* (L.) *A. lariciatus* (Patch) and *Pineus similis* (Gill.)	White spruce Black spruce	Northern region	Unusually high populations occurred in numerous areas in plantations and on ornamentals and windbreaks.
		Sioux Lookout District	An incidence of 67% was recorded in a 28-ha plantation in the Vermilion River area.
		Pembroke District	Medium to high population in Wylie Township.
		Orono Forest Station	Low numbers on seed orchard stock.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Striped sumac leafroller *Nephopteryx subfuscella* (Rag.)	Sumac	Huronia, Maple, and Simcoe districts	High populations accounting for greater than 90% defoliation were often encountered.
Swaine jack pine sawfly *Neodiprion swainei* Midd.	Jack pine	Temagami and Kirkland Lake districts	Populations were generally low. Single island in Lake Temagami with 80% defoliation.
Tar spot *Rhytisma salicinum* (Pers.) Fr.	Willow	Chapleau and Gogama districts	Common throughout range of host trees averaging 10% or less foliar damage.
Tip blight *Sphaeropsis sapinea* (Fr.) Dyko & Sutt.	Scots pine Austrian pine	Maple and Cambridge districts	High rates of infection continue to cause significant mortality in plantations.
	Red pine White pine Austrian pine	North Bay, Pembroke, and Aylmer districts	Varying rates of infection and damage noted at several locations.
Twig blight *Cenangium ferruginosum* (Fr.) Fr.	Austrian pine	Huronia District	Top mortality was found in Mulmur Township.
Verticillium wilt *Verticillium albo-atrum* Reinke and Berth.	Sugar maple	Cambridge District	Light infection recorded in an ornamental planting.
Walnut caterpillar *Datana integerrima* G. & R.	Black walnut	Southwestern and central regions	Sporadic defoliation ranging as high as 75% on ornamentals, open-grown roadside, and plantation trees in the Simcoe, Wingham, Chatham, and Niagara districts. Light to moderate defoliation occurred in the city of Brampton, Maple District, and in Brantford Township, Cambridge District.
Water damage	Jack pine	Gogama District	About 470 000 seedlings died due to the combined effects of excessive soil moisture and cold soil temperatures at a prescribed burn site.
Western gall rust *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka	Jack pine Scots pine	Blind River and Pembroke districts	Stem cankers were recorded on 9% of the trees examined in the Blind River District. Experimental Scots pine at the Petawawa National Forestry Institute suffered high levels of damage and mortality.
		Northwestern, north–central, northeastern, and Algonquin regions	Low levels of damage averaging 2% incidence were noted at numerous locations.
White mold *Microstroma juglandis* (Bereng.) Sacc.	Basswood	Aylmer District	Single occurrence of low levels of infection to mature woodlot trees.
	Shagbark hickory	Niagara District	Low levels of foliar damage in a discrete pocket on mature ornamentals.
White pine blister rust *Cronartium ribicola* J.C. Fish.	White pine	Algonquin Park District	Cankers affecting 10% of 3-m trees and 2% mortality were noted in a plantation in Dickens Township.
		Sault Ste. Marie District	Evaluation disclosed a 26% infection level in roadside regeneration in Labonte Township.

Insect, Disease, or Damage	Host(s)	Location	Remarks
White pine cone beetle *Conophthorus coniperda* (Schw.)	White pine	Huronia and Maple district	Single occurrence of heavily infested cones in each district.
White pine weevil *Pissodes strobi* (Peck)	Pine Spruce	Northern Ontario	Heaviest populations occurred in the Timmins, Temagami, and Kirkland Lake districts where leader damage ranged from 11 to 19%.
		Southern Ontario	High numbers recurred in the Owen Sound District. Other areas of high leader damage counts were 13% in North Walsingham and Windham townships, Wingham District; 33% in Orillia Township, Huronia District; and 17% at Balsam Lake Prov. Park, Lindsay District.
Willow leafminer *Micrurapteryx salicifoliella* (Cham.)	Willow	Geraldton, Terrace Bay, Nipigon, Hearst, Kirkland Lake, and Timmins districts	Severe widespread browning of foliage reported.
Wind damage	Hardwoods and conifers	Huronia, Bracebridge, and Lindsay districts	About 715 ha destroyed in direct path of tornado, plus numerous pockets of wind-damaged trees.
		Geraldton, Carleton Place, Brockville districts and Algonquin region	Fall storms spawned high winds which damaged trees at numerous locales.
Winter drying	Red pine	Red Lake and Kenora districts	Severe foliar damage noted in towns of Kenora, Red Lake, and Balmertown.
	Red pine	Sioux Lookout and Ignace districts	Similar damage to roadside plantings and right-of-ways.
	Black spruce	Thunder Bay district	Container stock mortality amounted to 1.9 million seedlings at nursery.
	Red pine White pine	Central region	Several instances of heavy damage noted including roadside plantations.
	White pine Red pine	Algonquin region	Damage reported along corridors of hwys 17, 62, 28, and 60.
Yellowheaded spruce sawfly *Pikonema alaskensis* (Roh.)	White spruce	Northern region	Pockets of heavy damage occurred in plantations located in the Timmins, Kirkland Lake, and Cochrane districts.
		North–central region	Light levels of defoliation scattered throughout the region.
		Northwestern region	Small areas of severe defoliation recurred in the Ignace and Sioux Lookout districts.

Other Insects, Diseases, and Damage

Western and Northern Region

Insect, Disease, or Damage	Host(s)	Location	Remarks
Armillaria root rot *Armillaria mellea* (Vahl ex Fr.) Kumm.	Pine	Prairie provinces	Low but significant tree mortality occurred in natural regeneration and plantations. In Manitoba, tree mortality in red pine plantation continued.
Birch leafminers *Fenusa pusilla* (Lep.) *Heterarthrus nemoratus* (Fall.) *Profenusa thomsoni* (Konow)	Birch species	Prairie provinces	Light, moderate, and severe damage persisted in most major urban areas. Remains common throughout forest stands.
Chemical injury	Several species	Prairie provinces	Increased reports of mortality and injury to nontarget trees by chemicals, especially soil sterilants in urban areas.
Cytospora canker *Cytospora chrysosperma* Pers. ex Fr.	Poplar	Alberta	Common on host trees in most urban areas.
Dwarf mistletoes *Arceuthobium americanum* Nutt. ex Engelm. *A. pusillum* Pk.	Lodgepole pine Jack pine Spruce	Prairie provinces	A perennial problem; causes severe witches' broom, stem deformation, reduced growth, and tree mortality, especially in jack pine stands.
European spruce sawfly *Gilpinia hercyniae* (Htg.)	Spruce	Manitoba	Spread as far north as Silver Falls, Manitoba.
Fall cankerworm *Alsophila pometaria* (Harr.)	Manitoba maple White elm Green ash	Prairie provinces	Moderate to severe defoliation in scattered locations in southern and western Manitoba, and most urban areas in Saskatchewan. Low populations in Alberta.
Fire blight *Erwinia amylovora* (Burr.) Winslow et al.	Apple Cotoneaster Crabapple Hawthorn Mountain-ash	Alberta Saskatchewan	Increase in infections on mountain-ash occurred in both provinces.
Frost damage	Many species	Prairie provinces Northwest Territorires	Significant increase in some areas. Damage was especially evident on Colorado spruce and Scots pine, in plantations and nursery area.
Hypoxylon canker *Hypoxylon mammatum* (Wahl.) J.H. Miller	Aspen	Prairie provinces	Canker infections occurred in most native stands examined in Alberta and Saskatchewan.
Ice storm damage	Lodgepole pine	Northwest Territories	Ice storms accompanied by high winds severely damaged pine trees in two areas.
Introduced pine sawfly *Diprion similis* (Htg.)	Scots pine	Manitoba	First detected in 1983 near Winnipeg, the distribution remained unchanged.
Larch casebearer *Coleophora laricella* (Hbn.)	Larch	Manitoba	Low populations occurred in one area in Manitoba.

Insect, Disease, or Damage	**Host(s)**	**Location**	**Remarks**
Larch sawfly *Pristiphora erichsonii* (Htg.)	Larch	Prairie provinces Northwest Territories	Defoliation remained light except for a few areas in Manitoba and the Northwest Territories where moderate to severe defoliation occurred.
Large aspen tortrix *Choristoneura conflictana* (Wlk.)	Aspen	Alberta Manitoba	Moderate to severe defoliation in small areas in southern Alberta and southern Manitoba.
Lodgepole terminal weevil *Pissodes terminalis* Hopping	Pine	Prairie provinces	Common. Present in most plantations surveyed.
Northern pitch twig moth *Petrova albicapitana* (Bsk.) *P. metallica* (Bsk.)	Jack pine Lodgepole pine	Prairie provinces	Very common in jack pine plantations in Saskatchewan. Common in native pine stands in Alberta.
Pear sawfly *Caliroa cerasi* (L.)	Mountain-ash Cotoneaster Apple Plum	Alberta Saskatchewan	Common pest on host species in urban areas.
Pine engraver *Ips pini* (Say)	Jack pine	Northwest Territories	Fewer beetle-attacked trees
Pine root collar weevil *Hylobius radicis* Buch.	Pine Spruce	Manitoba Alberta	Occurred in low numbers in pine plantations and regeneration.
Pinewood nematode *Bursaphelenchus xylophilus* (Steiner & Buhrer) Nickle	Balsam fir Jack pine Lodgepole pine	Manitoba Alberta	Few samples taken from dead or dying trees, but pinewood nematode not identified.
Porcupine damage	Jack pine Lodgepole pine	Northwest Territories	Several groups of 20–40 pine trees damaged.
Rabbit damage	Jack pine	Northwest Territories	Occasional tree mortality along roads.
Red belt injury	Lodgepole pine	Northwest Territories	Moderate to severe red belt damage in Nahanni National Park.
Scleroderris canker *Gremmeniella abietina* (Lagerb.) Morelet	Lodgepole pine	Alberta	Found only in known areas of Jasper National Park.
Silver leaf *Stereum purpureum* (Pers. ex Fr.) Fr. (= *Chondrostereum purpureum*)	Mountain-ash Apple Cotoneaster Other species	Alberta	A general decline, but continues to be a common problem on older mature plants in many urban areas.
Spruce gall adelgids *Adelges cooleyi* (Gill.) *Pineus similis* (Gill.) *P. pinifoliae* (Fitch)	Spruce Pine	Prairie provinces Northwest Territories	Damage light but common in several areas. Moderate to severe damage in one area in the Northwest Territories.
Spruce spider mite *Oligonychus ununguis* (Jac.)	Spruce Juniper Cedar	Prairie provinces	Common in Alberta and Saskatchewan especially on mature and semimature trees in urban areas.
Two-year-cycle spruce budworm *Choristoneura biennis* Free.	Alpine fir Engelmann spruce	Alberta	Low or endemic populations in the Rocky Mountain national parks.
Western gall rust *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka	Lodgepole pine Jack pine	Prairie provinces Northwest Territories	Common at low levels in scattered young pine regeneration and plantations.

Insect, Disease, or Damage	Host(s)	Location	Remarks
White pine weevil *Pissodes strobi* (Peck)	Spruce Pine	Prairie provinces	Spruce and pine leader mortality. Common on young trees in Saskatchewan and Alberta.
Willow leafminer *Lyonetia* sp.	Willow	Prairie provinces Northwest Territories	Moderate to severe damage occurred in several scattered areas in the provinces and the Northwest Territories.
Winter drying	Several species	Prairie provinces	Foliage browning increased and was common especially on spruce, Scots pine, and cedars.
Yellowheaded spruce sawfly *Pikonema alaskensis* (Roh.)	Spruce	Prairie provinces Northwest Territories	Noticeable increase in populations. Moderate to severe damage was common in several areas. Light to moderate defoliation occurred in a few areas in the Northwest Territories.

Other Insects, Diseases, and Damage

Pacific and Yukon Region

Insect, Disease, or Damage	Host(s)	Location	Remarks
Alder leafminer *Lithocolletis* sp.	Red alder	Prince Rupert region	Moderate defoliation in the Suskwa River Valley.
Allegheny spruce beetle *Dendroctonus punctatus* LeC.	White spruce	Yukon	Collected in the La Biche River Valley, the first in the Yukon for more than 25 yr.
		Prince George region	Collected for the first time in B.C., west of Mackenzie, from stressed, mature spruce.
Ambermarked birch leafminer *Profenusa thomsoni* (Konow)	White birch Trembling aspen	Prince George region	First collection west of Rocky Mtns.; infested about 1 ha in Prince George.
Anthracnose *Gloeosporium* sp.	Dogwood	Vancouver region	Infections decreased for the 2nd consecutive year on the lower mainland and east coast of Vancouver Island.
Ascocalyx canker *Ascocalyx* sp.	White spruce	Prince Rupert region	Collected near Telkwa; a first record on spruce in B.C.
Atropellis canker *Atropellis piniphila* (Weir) Lohman & Cash	Lodgepole pine	All regions	Widespread throughout host range.
		Prince Rupert region	Killed 7% and infected 55% of a 60-yr-old stand in the Telkwa River drainage.
Bark maggot *Cheilosia* sp.	Western hemlock	Prince Rupert region	In 4% of a semimature stand north of Terrace; causes the "black check" lumber defect.
Bedstraw hawkmoth *Hyles gallii* (Rott.)	Herbaceous plants	Prince George region	Severe defoliation of hosts by increased populations in recently burned and planted areas, but conifer seedlings were not affected.
Birch leafminer *Lyonetia saliciella* Bsk.	White birch	Kamloops region	40-100% of foliage infested in groves totalling 3100 ha from Barrière east to Adams Lake.
		Nelson region	Increase in the Columbia Valley and adjacent drainages, from north of Radium to Donald.
		Prince George region	Severe defoliation between Tête Jaune Cache and Grant Brook.
		Prince Rupert region	Common at low levels.
Black army cutworm *Actebia fennica* (Tausch.)	Spruce Pine Douglas-fir	Prince Rupert, Prince George, Cariboo regions	Seedling mortality at 10 of 31 burned planting sites (see also "Pests in young stands and plantations," this report).
Black stain root disease *Ceratocystis wagenerii* (Kend.) Goheen & Cobb	Douglas-fir	Vancouver Island	First reported in B.C. in 1976 and since found in many areas in the southern half of the province; caused patchy mortality near Courtenay and on Quadra Island.
Black willow leaf beetle *Pyrrhalta punctipennis* (Mann.)	Red alder	Prince Rupert region	Severely defoliated patches up to 10 ha in the Skeena, Kallum, and Kitimat valleys.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Brown felt blight *Herpotrichia juniperi* (Duby) Petr.	Douglas-fir	Vancouver Island	Moderately infected 10% of the saplings in a plantation near Northwest Bay.
Cedar bark beetle *Phloeosinus cupressi* (Hopk.)	Yellow cedar	Prince Rupert region	In single or groups of one to five stressed and dying trees in the Rennell Sound area on the Queen Charlotte Islands
Cooley spruce gall adelgid *Adelges cooleyi* (Gill.)	Engelmann spruce	Prince George, Nelson, Cariboo regions	Moderate to heavy localized infestations in plantations throughout the regions.
	Sitka spruce Douglas-fir	Prince Rupert region	Moderate infestations in Douglas-fir plantations near Burns Lake and Houston; very light in the Kitimat Valley on spruce saplings.
	Sitka spruce	Vancouver Island	Common, with occasional large populations.
Cypress tip moth *Argyresthia* sp.	Ornamental cypress	Vancouver Island	Severe discoloration and mortality of branch tips and trees for the 3rd consecutive year, from Victoria to Campbell River.
Discocainia canker *Discocainia treleasei* (Sacc.) Reid & Funk	Sitka spruce	Prince Rupert region	Cortical scarring on 10% of the spruce in a stand near Terrace.
Douglas-fir beetle *Dendroctonus pseudotsugae* Hopk.	Douglas-fir	All regions	Scattered mortality over 1800 ha in B.C.; populations remained at relatively low levels except in the Cariboo region where infestations increased slightly to 1470 ha. Douglas-fir tussock moth-defoliated trees attacked in a few pockets of two to five trees over 60 ha, a decline after the 3rd year of beetle infestation.
Douglas-fir cone scale midge *Contarinia washingtonensis* Johns.	Douglas-fir	Vancouver Island	Average of 4.5% (0–55%) of the cones assessed were infested.
Douglas-fir gall midge *Contarinia oregonensis* Foote	Douglas-fir	Vancouver Island	Average of 5.5% (2.5–20%) of cones infested.
Douglas-fir tussock moth *Orgyic pseudotsugata* (McD.)	Douglas-fir	Kamloops region	Four stands totalling 70 ha severely defoliated. Natural controls (virus and dipterous parasites) declined significantly in recent years. Mortality from past defoliation in 61 stands sampled averaged 55% and 66% for mature and immature stands, respectively. Of surviving trees, 17% of mature and 2% of immature were top-killed after 1–3 yr of defoliation.
Dwarf mistletoe *Arceuthobium tsugense* (Rosendahl) G.N. Jones	Western hemlock	Prince Rupert and Vancouver regions	Widespread in patches throughout the coastal host range causing significant growth loss.
Elytroderma disease *Elytroderma deformans* (Weir) Darker	Ponderosa pine	Cariboo, Kamloops, Nelson regions	Light and moderate needle infection and brooming common throughout the host range. Average of 35% of 1984 foliage infected in several areas of the Kamloops region.

Insect, Disease, or Damage	Host(s)	Location	Remarks
European alder leafminer *Fenusa dohrnii* (Tisch.)	Red alder	Prince Rupert region	Light discoloration throughout the southern portion of the region.
European larch canker *Lachnellula willkommii* (Hartig) Dennis	Western larch Tamarack Alpine larch	All regions	Surveys negative for 5th consecutive year.
European pine shoot moth *Rhyacionia buoliana* (D.&S.)	Pines	Vancouver Island	Minor damage to mugho and other ornamental pines continues from Victoria to Courtenay.
		Kamloops region	Captured in pheromone traps in Kelowna, ornamental pines lightly infested but damage not evident in native pines.
Fall webworm *Hyphantria cunea* (Drury)	Deciduous trees	Vancouver region	Populations declined for the 2nd consecutive year on the lower mainland and east coast of Vancouver Island.
Fir budmoths *Zeiraphera* spp.	Amabilis fir	Vancouver Island	Foliar feeding, bark scoring, and tip mortality of 0-84% (avg 38%) of leaders and top crown laterals in mixed stands near Campbell River and Nanaimo.
Frost damage	Western hemlock Sitka spruce Amabilis fir Lodgepole pine	Prince Rupert, Prince George, Cariboo, Nelson regions	Late spring frost killed newly flushed buds and leaders in exposed patches of plantations over widespread areas. The severe winter killed numerous branches on lodgepole pine in a Prince George seed orchard.
Glomerella blight *Colletotrichum gloeosporioides* Penz.	Willows	Prince Rupert region	Severe defoliation and dieback of scattered roadside willow south of Houston; a new host record.
Greenstriped forest looper *Melanolophia imitata* (Wlk.)	Douglas-fir Western hemlock	Prince Rupert and Vancouver regions	Endemic populations continue.
Hemlock-willow foliar rust *Melampsora epitea* Thüm.	Willow	Prince Rupert region	Early yellowing and leaf drop on scattered trees in Skeena, Kallum, and Kitimat valleys.
Larch budmoth *Zeiraphera improbana* (Wlk.)	Western larch	Nelson and Kamloops regions	Infestations intensified in numerous patches totalling 14 800 ha in the west Kootenay and east of the Okanagan Valley.
Larch casebearer *Coleophora laricella* (Hbn.)	Western larch	Kamloops and Nelson regions	Decreased to small patches of trace defoliation in Kamloops region and west Kootenay; in the east Kootenay defoliation intensity declined over 40 000 ha.
Larch sawfly *Pristiphora erichsonii* (Htg.)	Western larch Tamarack	Nelson region	Infestations declined with only small pockets of trace defoliation in the Flathead Valley.
		Vancouver region	Exotic larches moderately defoliated in UBC Research Forest near Haney.
		Yukon Territory	Light defoliation occurred in the La Biche River Valley, but defoliation along Simpson Lake, north of Watson Lake, and along the Tungsten Highway declined from 1984 levels.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Larch shoot moth *Argyresthia laricella* Kft.	Western larch	Nelson region	Killed branch tips on 15% of the regeneration near Radium.
Large aspen tortrix *Choristoneura conflictana* (Wlk.)	Trembling aspen	Yukon Territory	Declining populations, lightly defoliated small patches south of Carmacks.
Leaf rusts *Didymascella thujina* (Durand) Maire	Western red cedar	Nelson region	Moderate to severe foliar browning along Blaeberry River.
		Vancouver Island	Light infections common throughout host range.
Melampsora medusae Thüm.	Douglas-fir	Nelson region	Semimature stands lightly infected from Radium to Golden.
	Tamarack	Yukon Territory	Infections declined along the Tungsten Highway due to the drier weather.
M. occidentalis Jacks.	Black cottonwood	Prince Rupert region	Premature yellowing and leaf drop from saplings common in southwest portion of region.
	Douglas-fir	Cariboo and Vancouver regions	Moderate and severe foliar yellowing near Riske Creek and in plantations near Hagensborg.
Leather-winged beetles *Podabrus* sp.	All conifer species	Prince Rupert region	A beneficial insect predatory on aphids, common throughout southern region.
Lodgepole pine beetle *Dendroctonus murrayanae* Hopk.	Lodgepole pine	Yukon Territory	Attacked damaged mature trees in a seed collection area near Stewart Crossing and south of Mayo.
Lodgepole terminal weevil *Pissodes terminalis* Hopping	Lodgepole pine	Cariboo, Prince George, Prince Rupert regions	Increased; affected up to 27% of the current leaders near Riske Creek, Big Creek, and Taseko Lakes. Trace to light infestations south of Prince George and eastern Prince Rupert region.
Needle blight *Leptomelanconium pinicola* (Berk. & Curt.) Hunt	Ponderosa pine	Nelson region	Infections increased in east Kootenay affecting up to 60% of the current foliage.
Meria laricis Vuill.	Western larch	Nelson and Kamloops regions	Infections declined to light intensity due to drier weather.
Needle casts *Elytroderma deformans* (Weir) Darker	Ponderosa pine	Cariboo, Kamloops, Nelson regions	Light and moderate needle infection and brooming common throughout the host range. Average of 35% of 1984 foliage infected in several areas of the Kamloops region.
Hypodermella laricis Tub.	Western larch	Nelson and Kamloops regions	Infections declined to light intensity due to drier weather.
Lophodermella concolor (Dearn) Darker *L. montivaga* Petr. *Lophodermium* sp.	Lodgepole pine	All regions	Conspicuous and severe defoliation continued in the Kamloops region and in parts of the Nelson, Prince George, and Prince Rupert regions. Defoliation was light throughout Vancouver Island and the eastern portion of the Prince Rupert region.
Phaeocryptopus gaeumannii (Rohde) Petr.	Douglas-fir	Vancouver Island	30–100% of trees in plantations and seed orchards were lightly to severely infected.
Rhabdocline spp.	Douglas-fir	All regions	Some local increases, but generally reduced infection levels in B.C.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Needle rusts *Chrysomyxa weirii* Jacks.	Engelmann spruce White spruce	Nelson, Prince George, Prince Rupert, Vancouver Island	Common, but light.
Coleosporium asterum (Diet.) Syd.	Lodgepole pine	Nelson region	Lightly infected plantations east of Golden.
Northern spruce engraver *Ips perturbatus* (Eichh.)	White spruce	Prince George and Cariboo regions	About 4000 trees top-killed, most in the Torpy River drainage; low incidence in the Bowron Lake area.
Omnivorous leaftier *Cnephasia longana* (Haw.)	Amabilis fir	Vancouver Island	Severe defoliation of new growth on 86% of the seedlings at a seed orchard near Nanaimo. Light defoliation of 18% of the seedlings at a Saanich seed orchard.
Pacific willow leaf beetle *Pyrrhalta decora carbo* (LeC.)	Willow	Prince Rupert and Prince George regions	Severe defoliation near Kitwanga and Prince George.
		Vancouver Island	Skeletonized foliage over 4300 ha near Port Alberni.
		Nelson region	Common at low levels.
Pine adelgids *Pineus* spp.	Lodgepole pine Western white pine	Prince Rupert region	Moderate to severe in patches near Babine Lake.
		Prince George and Nelson regions	Sporadic, with scattered infestations in plantations in west Kootenay.
Pine engraver *Ips pini* (Say)	Lodgepole pine	Cariboo region	2–5% of the unsuccessfully mountain pine beetle-attacked pine were infested in the Chilcotin.
Pine needle sheathminer *Zelleria haimbachi* Bsk.	Lodgepole pine	Kamloops and Prince Rupert regions	Increased populations severely discolored up to 30% of the 1985 shoots on most of the regeneration over more than 50 ha near Salmon Arm, but incidence was light near Babine Lake.
Pitch nodule makers *Petrova albicapitana* (Bsk.) *P. metallica* (Bsk.)	Lodgepole pine	All regions	Adults found in pheromone traps but no larval damage to trees noted.
Poplar-and-willow borer *Cryptorhynchus lapathi* (L.)	Willow	Prince Rupert region	High numbers of shoots and stems killed.
Poplar leaffolding sawfly *Phyllocolpa bozemani* (Cooley)	Black cottonwood	Prince Rupert region	Leafrolling common throughout the Kallum Valley.
Poplar shoot blight *Venturia macularis* (Fr.) E. Müll & Arx	Trembling aspen	Prince Rupert region	Severe defoliation over 10 000 ha from Kitwanga to Cedarvale. Lighter infections elsewhere in the region.
		Nelson and Prince George regions	Infections declined to very light.
Red band disease *Scirrhia pini* Funk & Parker	Western white pine Lodgepole pine	Prince George, Prince Rupert, Nelson, Kamloops regions	Infections declined in stands severely infected in 1984.
Rodent damage Porcupine, squirrel	Lodgepole pine Western hemlock White spruce	Prince Rupert and Nelson regions	Tree mortality and top-kill increased and was widespread.
		Prince George region	Sporadic damage similar to previous years.
Salt damage	Douglas-fir	Nelson and Cariboo regions	Single and groups of one to five trees killed near Cranbook and Williams Lake.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Satin moth *Leucoma salicis* (L.)	Trembling aspen Black cottonwood	Cariboo, Nelson, Kamloops regions and Vancouver Island	Moderate to severe defoliation for the 3rd consecutive year in widely scattered pockets. Northward extension of range to Williams Lake. Light defoliation continued in the Victoria area.
Sawflies *Neodiprion* spp.	Lodgepole pine	Nelson region	Up to 90% defoliation near Creston over 100+ ha.
	Western hemlock Alpine fir	Kamloops region	Moderate defoliation of older pine needles occurred in some mature stands.
		Prince George region	Trace to light defoliation north of McBride over 500 ha.
		Prince Rupert region	Severe defoliation combined with the blackheaded budworm in some areas on the Queen Charlotte Islands. Light defoliation on shore pine on Graham Island.
Secondary fungus *Leptosphaeria* sp.	Sitka alder	Prince George region	New host record of this "secondary" fungus.
Seedling weevil *Steremnius carinatus* (Boh.)	Douglas-fir Western hemlock Amabilis fir Western red cedar Sitka spruce Grand fir	Vancouver Island	Girdling and mortality in new plantations averaged 5% (0–12%) of the seedlings of several species.
Sequoia pitch moth *Synanthedon* sp.	Lodgepole pine	Vancouver Island and Nelson region	Sporadic throughout host range; pockets of severe attack in the Victoria area. Moderate infestation in natural regeneration at Skookumchuck.
Silverspotted tiger moth *Lophocampa argentata* (Pack.)	Douglas-fir	Vancouver Island	Less than in previous years, occasional partial defoliation of single branches from Victoria to Campbell River.
Snow breakage	Lodgepole pine	Prince Rupert region	14% of the stems were broken in a recently spaced 45-yr-old stand near Burns Lake.
Snow mold fungi *Phacidium sherwoodiae* Di Cosmo, Nag Raj & Kendrick	Western larch	Nelson region	New regional host record; killed 16% of seedlings in a 1982 planting near Grand Forks.
Apostrasseria lunata (Shear) Nag Raj	Douglas-fir Western white pine	Nelson region	New host records. Light to moderate mortality of small numbers of seedlings at a 20-ha site near Revelstoke.
Snowshoe hare	Sitka spruce	Prince Rupert region	Clipped leaders and branches in patches in plantations in the Kitimat and Kallum valleys.
Spotted tussock moth *Lophocampa maculata* Harr.	Red alder	Prince Rupert region	Light defoliation in the Lakelse area.
Spruce aphid *Elatobium abietinum* (Wlk.)	Sitka spruce	Queen Charlotte Islands	Populations declined overall. Infestations continued on the east coast of Graham Island where mature trees have been killed by years of continual feeding and most old needles have been killed in some plantations.
		Vancouver region	Light defoliation of older needles in five seed orchards.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Spruce broom rust *Chrysomyxa arctostaphyli* Diet.	White spruce	All regions	Common within the host range.
Spruce needle rust *Chrysomyxa weirii* Jacks.	Engelmann spruce White spruce	Nelson, Prince George, Prince Rupert, Vancouver Island	Common but light.
Striped alder sawfly *Hemichroa crocea* (Geoff.)	Red alder	Prince Rupert region	Patchy severe defoliation from Kitimat to Terrace.
Tar spot *Rhytisma salicinum* (Pers.) Fr.	Willow	Prince Rupert region	Light in the Kitimat and Kallum valleys.
Terminal crook disease *Colletotrichum acutatum* Simmonds	Western hemlock	Vancouver Island	A fifth annual survey of previously infested outplanted stock was negative for this introduced fungus.
Tip blight *Delphinella* spp.	Alpine fir	Prince George region	Infections widespread throughout southern region, but less severe than in 1984 averaging 20% of the current buds killed.
Twig beetle *Pityophthorus* sp.	Lodgepole pine	Prince Rupert region	Occasional top dieback of saplings, similar to terminal weevil damage.
Western balsam bark beetle *Dryocoetes confusus* Swaine	Alpine fir	All regions	Mortality continues in chronically infested stands. Increased mortality in the eastern Prince Rupert Region.
Western false hemlock looper *Nepytia freemani* Mun.	Douglas-fir	Nelson region	Two small outbreaks over about 50 ha north of Invermere.
Western gall rust *Endocronartium harknessii* (Moore) Y. Hirat.	Lodgepole pine	Prince Rupert region	Near Ootsa Lake 8% of the stems in young stands were broken at galls. In a nearby spaced stand 11% of the volume in a 35-yr-old stand was lost.
		Yukon	Infected 5% of the immature pine in a provenance trial near Watson Lake and 1% of an immature stand near Whitehorse.
		Vancouver region	6% of young pine were killed and 17% of the infected trees had stem breakage in Manning Prov. Park. Up to 100% of stems were infected in stands on southern Vancouver Island and up to 5% of the regeneration was killed by stem breakage at a gall.
		Other regions	Present throughout the host range.
Western hemlock looper *Lambdina fiscellaria lugubrosa* (Hulst)	Western hemlock Western red cedar	Kamloops, Cariboo, Nelson, Prince George regions	Populations collapsed due to parasitism and virus. Light tree mortality and moderate top-kill occurred near Quesnel Lake and Upper and Lower Arrow lakes.
Western oak looper *Lambdina fiscellaria somniaria* (Hulst)	Garry oak	Saltspring Island	Population collapsed; no damage noted in 1985.
Western pine shoot borer *Eucosma sonomana* Kft.	Ponderosa pine	Nelson region	Caused leader deformity of 2% of trees at one site near Christina Lake.

Insect, Disease, or Damage	Host(s)	Location	Remarks
Western tent caterpillar *Malacosoma californicum* (Pack.)	Deciduous species	Nelson region	Second year of severe defoliation over 125 ha near Trail.
		Vancouver region	Expanded for 4th consecutive year on southern Vancouver Island and the lower mainland causing severe defoliation in some areas.
		Prince Rupert region	Populations declined to trace levels.
White pine weevil *Pissodes strobi* (Peck)	Sitka spruce White spruce Englemann spruce	Prince Rupert region	Average 26% (2–51%) of saplings currently attacked in the Skeena, Kallum, and Kitimat valleys.
		Vancouver Island	5–35% (avg 17%) of current leaders attacked in six stands.
		Prince George and Nelson regions	Sporadic occurrence; 25% leader mortality in a recently spaced plantation southeast of Prince George.
Winter drying	Lodgepole pine	Yukon	Severe foliar browning on more than 90% of the trees in 1- to 2-ha pockets between Watson Lake and Carmacks. About 6% of the immature trees in provenance trials near Watson Lake were lightly affected.
Winter moth *Operophtera brumata* (L.)	Garry oak Maples Fruit trees	Southeastern Vancouver Island Lower mainland	Defoliation similar in extent to previous years throughout the Victoria area but much reduced in intensity, partly due to parasite releases 1979-82; 48% of the 1985 larvae were parasitized. Pheromone traps at 25 sites confirmed the presence of winter moth between Victoria and Nanaimo and at Richmond and Tsawwassen. No moths were found between Nanaimo and Campbell River, at Sooke, White Rock, or along False Creek in Vancouver.
Woolly alder sawfly *Eriocampa ovata* (L.)	Red alder	Prince Rupert region	Introduced from Europe in the 1930s, the insect caused severe defoliation in the vicinity of the Prince Rupert Municipal Campground.

Selected Bibliography

The following list includes reports and publications produced in 1985 by the staff of the Canadian Forestry Service. Copies may be obtained from the originating forestry center.

Newfoundland Forestry Centre

Clarke, L.J.; Carew, G.C. 1985. Forecast of forest insect and disease conditions in Newfoundland and Labrador in 1985. Can. For. Serv., Nfld. For. Cent. Woody Points 14(2):3.

Clarke, L.J.; Carew, G.C. 1985. Forest insect and disease conditions in Newfoundland and Labrador in 1985 — mid-season report. Can. For. Serv., Nfld. For. Cent. Woody Points 14(3):2.

Raske, A.G. 1985. Economic impact of exotic forest insects in Atlantic Canada. Invited paper and abstract. Proc. Acadian Ent. Soc. 4 p.

Raske, A.G.; Alvo, H. 1985. Vulnerability of forest types to spruce budworm damage in Newfoundland — an empirical approach based on large sample size. Forest Entomol. Monographs, Germany.

West, R.J. 1985. Native and introduced parasites of the potato stem borer, *Hydraecia micacea* (Lepidoptera: Noctuidae). A paper presented to the Acadian Entomological Society, August 1985, St. John's, Nfld.

West, R.J.; Lim, K.P. 1985. Efficacy of aerial sprays of *Bacillus thuringiensis* against the hemlock looper in balsam fir stands. A paper presented to the annual meeting of the Entomological Society of America, December 1985, Hollywood, Fla.

Canadian Forestry Service—Maritimes

Allen, D.C.; Dorais, L.; Kettela, E.G. 1984. Survey and detection. Pages 21-26 *in* Managing the spruce budworm in eastern North America. USDA Agriculture Handbook No. 620.

Blum, B.M.; MacLean, D.A. 1984. Silviculture, forest management and the spruce budworm. Pages 83-102 *in* Managing the spruce budworm in eastern North America. USDA Agriculture Handbook No. 620.

Coady, L.J. 1985. Forest insects and diseases in Prince Edward Island National Park in 1984. Marit. For. Res. Cent. Tech. Note No. 127.

Cormier, J.R. 1985. Forest insects and diseases in Fundy National Park in 1984. Marit. For. Res. Cent. Tech. Note No. 125.

Cormier, J.R. 1985. Forest insects and diseases in Kouchibouguac National Park in 1984. Marit. For. Res. Cent. Tech. Note No. 126.

Eidt, D.C. 1985. Toxicity of *Bacillus thuringiensis* var. *kurstaki* to aquatic insects. Can. Entomol. 117:829–837.

Embree, D.G.; Estabrooks, G.F.; Marks, D.; Renault, T.R. 1985. Efficacy studies of Diazinon 500 EC against the balsam gall midge on balsam fir Christmas trees in Nova Scotia. Marit. For. Res. Cent. Tech. Note No. 131.

Estabrooks, G.F.; Kettela, E.G.; Embree, D.G. 1985. Field trials of Diazinon 50 EC against the balsam gall midge, *Paradiplosis tumifex* Gagne, in Nova Scotia, 1985. Marit. For. Res. Cent. Tech. Note No. 146.

Irland, L.C.; Runyon, K.L. 1984. Economics of spruce budworm management strategy. Pages 65-82 *in* Managing the spruce budworm in eastern North America. USDA Agriculture Handbook No. 620.

MacCall, C.D. 1985. Forest insects and diseases in Cape Breton Highlands National Park in 1984. Marit. For. Res. Cent. Tech. Note No. 129.

Macay, A.W. 1985. Forest insects and diseases in Kejimkujik National Park in 1984. Marit. For. Res. Cent. Tech. Note No. 128.

MacLean, D.A. 1985. Predicting the risk of spruce budworm damage using hazard rating and vulnerability rating systems. Pages 113-120 *in* Spruce-Fir Management and Spruce Budworm. USDA For. Serv. Broomall, Pa. Gen. Tech. Rep. NE-99.

Magasi, L.P. 1985. Forest pest conditions in the Maritimes 1984. Can. For. Serv., Marit. For. Res. Cent. Inf. Rep. M-X-154.

Magasi, L.P. 1985. Highlights of forest pest conditions in the Maritimes in mid-June 1985. Marit. For. Res. Cent. Tech. Note No. 139.

Magasi, L.P. 1985. Highlights of forest pest conditions in the Maritimes in mid-September 1985. Marit. For. Res. Cent. Tech. Note No. 144.

Magasi, L.P.; Pond, S.E.; Urquhart, D.A. 1985.

Still the city of stately elms: Fredericton after 25 years of Dutch elm disease — 1985. Can. For. Serv. — Marit. Tech. Note No. 147.

Marks, D.B.; Renault, T.R. 1985. The Dutch elm disease prevention program works! A case study. Marit. For. Res. Cent. Tech. Note No. 132.

Neilson, M.M. 1985. Spruce budmoth — a case history, issues and constraints. For. Chron. 61:252–255.

Ostaff, D.P. 1985. Age distribution of European larch canker in New Brunswick. Plant Dis. 69:796–798.

Pendrel, B.A. 1985. Forest tent caterpillar forecast for the Maritimes — 1985. Marit. For. Res. Cent. Tech. Note No. 130.

Pendrel, B.A. 1985. Population distribution of jack pine budworm — 1984, described through pheromone trapping. Marit. For. Res. Cent. Tech. Note No. 133.

Pendrel, B.A. 1985. Population distribution of European pine shoot moth — 1984, described through pheromone trapping. Marit. For. Res. Cent. Tech. Note No. 136.

Pendrel, B.A. 1985. Population distribution of the forest tent caterpillar — 1984, described through pheromone trapping. Marit. For. Res. Cent. Tech. Note No. 137.

Pendrel, B.A. 1985. Assessing spruce budmoth overwintering populations. Marit. For. Res. Cent. Tech. Note No. 141.

Pendrel, B.A.; Magasi, L.P. 1985. Spruce budworm defoliation on Prince Edward Island in 1985 and a forecast for 1986. Marit. For. Cent. Tech. Note No. 145.

Pendrel, B.A.; Renault, T.R. 1985. Insects and diseases in plantations. Pages 135-160 *in* R.D. Hallett, M.D. Cameron, and T.S. Murray, eds., Reforestation in the Maritimes 1984. Symposium proceedings, Moncton, N.B., April 3-4, 1984.

Pendrel, B.A.; Smith, T.D.; Magasi, L.P. 1985. Spruce budworm defoliation in Nova Scotia — 1985. Marit. For. Res. Cent. Tech. Note No. 142.

Shea, P.J.; Nigam, P.C. 1984. Chemical Control. Pages 115-132 *in* Managing the spruce budworm in eastern North America. USDA Agriculture Handbook No. 620.

Simmons, G.A.; Cuff, W.; Montgomery, B.A.; Hardman, J.M. 1984. Integrated pest management. Pages 11-20 *in* Managing the spruce budworm in eastern North America. USDA Agriculture Handbook No. 620.

Teillet, P.M.; Leckie, D.G.; Ostaff, D. 1985. Spectral Measurements of Tree Defoliation. *In* Proceedings of the 3rd International Colloquium on the Spectral Signatures of Objects in Remote Sensing. Les Arcs, France. Dec. 19, 1985.

Titus, F.A.; Magasi, L.P. 1985. Highlights of forest pest conditions in the Maritimes at the end of June 1985. Marit. For. Res. Cent. Tech. Note No. 140.

Titus, F.A.; Magasi, L.P. 1985. Highlights of forest pest conditions at the end of July 1985. Marit. For. Res. Cent. Tech. Note No. 143.

Titus, F.A.; Meikle, O.A.; Harrison, K.J. 1985. Scientific and common names of insects and mites of interest in the Maritime Provinces. Marit. For. Res. Cent. Inf. Rep. M-X-155.

Wall, R.E.; Johnson, C.M. 1984. Effects of *Trichoderma* spp. on conifer seedlings and damping off. Abstract of paper presented at the annual meeting of the Canadian Phytopathological Society. University of Guelph, Guelph, Ont. August 12-16, 1984. Can. J. Plant Pathol. 6:268–269.

Witter, J.; Ostaff, D.; Montgomery, B. 1984. Damage assessment. Pages 37-64 *in* Managing the spruce budworm in eastern North America. USDA Agriculture Handbook No. 620.

Laurentian Forestry Centre

Archambault, L.; Beaulieu, J. 1985. Réduction de croissance en volume occasionnée au sapin baumier, suite à la défoliation par la tordeuse des bourgeons de l'épinette. For. Chron. 61 (1):10–13.

Beaubien, J.; Laframboise, P. 1985. Digital airbone and satellite data for evaluating spruce budworm damage in Quebec. Pages 235-240 *in* Proceedings Pecora remote sensing in forest and range resource management. Am. Soc. Photogram. Remote Sensing. Falls Church, Virginia.

Benhamou, N.; Ouellette, G.B. 1985. Mise en évidence de l'intrastructure et de certaines composantes biochimiques de champignon *Ascocalyx abietina*, l'agent de chancre scléroderrien de conifères. (Abst.) Phytoprotection 66:178.

Benhamou, N.; Ouellette, G.B. 1985. Les anticorps monoclonaux: une technologie de pointe en phytopathologie. Phytoprotection 66:5-15.

Benhamou, N.; Lafontaine, J.G.; Joly, J.R.; Ouellette, G.B. 1985. Ultrastructural localization in host tissues of a toxic glycopeptide produced by *Ophiostoma ulmi*, using monoclonal antibodies. Can. J. Bot. 63:1185-1195.

Benhamou, N.; Ouellette, G.B.; Lafontaine, J.G.; Joly, J.R. 1985. Use of monoclonal antibodies to detect a phytotoxic glycopeptide produced by *Ophiostoma ulmi*, the Dutch elm disease pathogen. Can. J. Bot. 63:1177-1184.

Benoit, P. 1985. Nomenclatura insectorum canadensium. 5e éd. Can. For. Serv., Laurentian For. Cent. 299 p.

Benoit, P. 1985. Opérations de lutte contre la tordeuse des bourgeons de l'épinette dans l'ouest du Québec en 1972. Can. For. Serv., Laurentian For. Cent., Sainte-Foy, Quebec. 172 p.

Blais, J.R. 1985. Epidemiology of the spruce budworm in Western Ontario: A discussion. For. Chron. 61 (6):494-498.

Blais, J.R. 1985. Impact of the spruce budworm on balsam fir and white spruce in the Laurentian Reserve, Quebec: an interim report. Can. For. Serv., Laurentian For. Cent., Sainte-Foy, Quebec. Inf. Rep. LAU-X-68.

Delisle, C.; Beaubien, J. 1985. Classifications forestières supervisées sur la base d'images LANDSAT-MSS accentuées. Can. For. Serv., Laurentian For. Cent., Sainte-Foy, Quebec.

Desrochers, P.; Ouellette, G.B. 1985. Évolution des traitements contre la maladie hollandaise de l'orme pour la région de Québec à partir des indices de scolytes 1984. Can. For. Serv. Laurentian For. Cent., Sainte-Foy, Quebec. 32 p.

Jobin, L. 1984. Mise à l'essai d'un piège à phéromone pour détecter et surveiller les populations de la tordeuse des bourgeons de l'épinette, *Choristoneura fumiferana* (Clem.). (Abst.) Page 295 *in* Annales de l'ACFAS, 51. 52e Congrès.

Kelly, B.; Régnière, J. 1985. Predation on pupae of the spruce budworm (Lepidoptera: Tortricidae) on the forest floor. Can. Entomol. 117:33–38.

Lachance, D. 1985. Répartition géographique et intensité du dépérissement de l'érable à sucre dans les érablières au Québec. Phytoprotection 66:83-90.

Lachance, D.; Laflamme, G. 1985. Le chancre scléroderrien menace les plantations de pin. La terre de chez nous. Sept. 1985: 8B.

Lachance, D.; Laflamme, G. 1985. Nouveau foyer d'infestation du chancre scléroderrien du pin, race européenne au Québec. (Abst.) Phytoprotection 66 (2):173.

Laplante, J.-P. 1985. Papillons et chenilles du Québec et de l'est du Canada. Éditions France-Amérique. Montreal, Que. 280 p.

Lavallée, A. 1986. Zones de vulnérabilité du pin blanc à la rouille vésiculeuse au Québec. For. Chron. 62:24–28.

Martineau, R. 1985. Insectes nuisibles des forêts de l'est du Canada / Insects Harmful to Forest Trees. Rapp. Tech. For. 32F. Can. For. Serv., Ottawa, Ont. and Éditions Marcel Broquet Inc. LaPrairie, Quebec.

Quednau, F.W. 1984. Lutte biologique contre la mouche à scie du sorbier, *Pristiphora geniculata* (Hartig), à l'aide d'un nouveau parasitoïde importé d'Europe. (Abst.) Page 295 *in* Annales de l'ACFAS, 51. 52e Congrès.

Quednau, F.W. 1985. Un relevé de la faune des pucereons (Homoptera:Aphididea) au Québec, réalisé dans des peuplements de feuillus, à l'aide de captures de pièges Malaise / A survey of aphid fauna (Homoptera:Aphididea) in Quebec hardwood forest stands by means of Malaise trap patches. Can. For. Serv., Laurentian For. Cent., Sainte-Foy, Quebec. Rapp. Inf. LAU-X-67.

Roberge, M. 1985. Nutrition et fertilisation de l'arbre d'ornement. (Abst.) Page 321 *in* Annales de l'ACFAS, 52-53. 53e Congrès.

Robert, J. 1984. Application aériennes expérimentale d'un insecticide biologique dans les forêts privées de la Gaspésie. Rapport synthèse. Can. For. Serv., Laurentian For. Cent., Sainte-Foy, Quebec. 8 p.

Robitaille, G.; Laflamme, D.; Boutin, R. 1984. Modifications chimiques des précipitations: l'influence de la couverture végétale et du sol forestier. (Abst.) Page 296 *in* Annales de l'ACFAS, 51. 52e Congrès.

Smirnoff, W.; Fillion, D. 1985. *Bacillus thuringiensis* — Futura: moyen de lutte efficace

contre la tordeuse des bourgeons de l'épinette en forêt privée. L'Aubelle 45 (Feb.):8–11.

Smirnoff, W.A. 1985. Field tests of a highly concentrated formulation of *Bacillus thuringiensis* against spruce budworm (*Choristoneura fumiferana*; Lepidoptera: Tortricidae). Can. Entomol. 117:877–881.

Villeneuve, N.; Grandtner, M.; Laflamme, G. 1985. La mycosociologie: ses origines, ses méthodes, ses applications au Québec. (Abst.) Page 40 *in* Annales de l'ACFAS, 52–53. 53e Congrès.

Great Lakes Forestry Centre

Biggs, W.D.; Jansons, V. 1985. Results of forest insect and disease surveys in the North Central Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 18. 30 p.

Brodersen, H.; Evans, J.H. 1985. Results of forest insect and disease surveys in the Southwestern Region on Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 23. 25 p.

Constable, D.C. 1985. Results of forest insect and disease surveys in the Northwestern Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 17. 29 p.

Cunningham, J.C.; Howse, G.M. 1984. Viruses: Application and Assessment. Pages 248–259 *in* J.S. Kelleher and M.A. Hulme, eds. Biological control programmes against insects and weeds in Canada 1969-1980. Commonwealth Agricultural Bureau.

Evans, J.H.; Sajan, R.J.; Brodersen, H. 1985. Results of forest insect and disease surveys in the Central Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 22. 35 p.

Gross, H.L. 1985. Multiple-leadered trees compare favorably with single-leadered trees in field performance tests of nursery stock. Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. 0-X-363.

Gross, H.L. 1985. White pine blister rust: a discussion of the disease and hazard zones for Ontario. Proc. Entomol. Soc. Ont. 116:72–79.

Gross, H.L. 1985. Impact of pests on the white pine resource of Ontario. Proc. Entomol. Soc. Ont. 116:33–37.

Harvey, G.T.; Sohi, S.S. 1985. Isozyme characterization of 28 cell lines from five insect species. Can. J. Zool 63:2270–2276.

Ingram, W.A. 1985. Results of forest insect and disease surveys in the Eastern Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 24. 36 p.

Kelly, B.; Régnière, J. 1985. Predation on pupae of the spruce budworm (Lepidoptera: tortricidae) on the forest floor. Can. Entomol. 117:33–38.

Lyons, D.B.; Van Baren, B. 1984. Comparison of the olfactometric response of *Hylurgopinus rufipes* and *Scolytus multistriatus* (Coleoptera: Scolytidae) to the synthetic pheromone Multilure® and its components. Can. For. Serv., Ottawa, Ont. CFS Res. Notes 4(4):50–51.

MacLeod, L.S.; Jones, C.G.; Keizer, A.J. Results of forest insect and disease surveys in the Northern Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 19. 51 p.

Nealis, V. 1985. Diapause and the seasonal ecology of the introduced parasite, *Cotesia (Apanteles) rubecula* (Hymenoptera: Braconidae). Can. Entomol. 117:333–342.

Richards, W.C.; Takai, S. 1984. Characterization of the toxicity of cerato-ulmin, the toxin of Dutch elm disease. Plant Pathol. 6:291–298.

Sajan, R.J.; Smith, B.E. 1985. Results of forest insect and disease surveys in the Algonquin Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 21.

Sanders, C.J. 1985. Flight speed of male spruce budworm moths in a wind tunnel at different wind speeds and at different distances from a pheromone source. Physiol. Entomol. 10:83–88.

Sanders, C.J. 1985. Disruption of spruce budworm, *Choristoneura fumiferana* (Lepidoptera: Tortricidae), mating in a wind tunnel by synthetic pheromone: role of habituation. Can. Entomol. 117:391–393.

Syme, P.D. 1984. *Rhyacionia buoliana* (Schiff.), European Pine Shoot Moth (Lepidoptera: Tortricidae). Pages 387-394 *in* J.S. Kelleher and M.A. Hulme, eds. Biological control programmes against insects and weeds in Canada 1969-1980. Commonwealth Agricultural Bureau.

Syme, P.D. 1984. Jack pine budworm. Can. For. Serv., Sault Ste. Marie, Ont. GLFC leaflet. 2 p. (produced in cooperation with the Ontario Ministry of Natural Resources). (Aussi disponible en français sous le titre «Tordeuse du pin gris.»)

Syme, P.D. 1985. Pine false webworm. Can. For. Serv., Sault Ste. Marie, Ont. GLFC leaflet. 2 p. (Aussi disponible en français sous le titre «Fausse tisseuse du pin.»)

Syme, P.D. 1985. Eastern white pine in Ontario: its entomological, pathological, physiological and other problems. Proc. Entomol. Soc. Ont. 116:21–31.

Thomson, M.J.; Czerwinski, E.J.; MacLeod, L.S.; Jansons, V. 1985. Results of forest insect and disease surveys in the Northeastern Region of Ontario, 1984. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 20. 50 p.

Wallace, D.R.; Sullivan, C.R. 1985. The white pine weevil, *Pissodes strobi* (Coleoptera: Curculionidae): a review emphasizing behaviour and development in relation to physical factors. Proc. Entomol. Soc. Ont. 116:39–62.

Weir, H.J.; Thomson, M.J.; Constable, D.C.; Jones, C.G. 1984. A review of important forest insect and disease problems in the North Bay District of Ontario, 1950-1980. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 14. 150 p. Appendices.

Weir, J.H.; Thomson, M.J.; Constable, D.C.; Jones, C.G. 1985. A review of important forest insect and disease problems in the Cochrane District of Ontario, 1950-1980. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 28. 110 p. Appendices.

Weir, J.H.; Thomson, M.J.; Constable, D.C.; Jones, C.G. 1985. A review of important forest insect and disease problems in the Blind River District of Ontario, 1950-1980. Can. For. Serv., Sault Ste. Marie, Ont. Misc. Rep. No. 30. 153 p. Appendices.

Whitney, R.D.; MacDonald, G.B. 1985. Effects of root rot on the growth of balsam fir. Can. J. For. Res. 15(5):890–895.

Northern Forestry Centre

Allen, E. 1985. Infection of young seedlings of lodgepole pine by *Endocronartium harnessii*. M.Sc. Thesis, University of Alberta.

Allen, E.; Hiratsuka, Y. 1985. Infection of young lodgepole pine seedlings with *Endocronartium harknessii*. (Abst.) Am. Phytopathol. Soc. Ann. Meet., Aug. 1985, Reno, Nevada. Phytopathology 75:1279.

Bella, I.E. 1985. Pest damage incidence in natural and thinned lodgepole pine in Alberta. For. Chron. 61:233–238.

Bella, I.E. 1985. Western gall rust and insect leader damage in relation to tree size in young lodgepole pine in Alberta. Can. J. For. Res. 15:1008–1010.

Cerezke, H.F. et al. 1985. Trees in the Urban Landscape. Alta. Agric. Publ. 40 p.

Drouin, J.A.; Wong, H.R. 1985. Life history and distribution of *Petrova metallica* (Lepidoptera: Tortricidae) in Alberta. (Abst.) Proc. Entomol. Soc. Alta. 32:8.

Hall, R.J.; Crown, P.H.; Titus, S.J. 1984. Change detection methodology for aspen defoliation with LANDSAT MSS digital data. Can. J. Remote Sensing 10:135–142.

Hiratsuka, Y. 1985. Cytology of an autoecious soft pine blister rust (*Peridermium yamahense*) in Japan. (Abst.) Am. Phytopathol. Soc. Ann. Meet., Aug. 1985, Reno, Nevada. Phytopathology 75:1279.

Mallet, K.I.; Hiratsuka, Y. 1985. Pathogenicity of Alberta isolates of the *Armillaria mellea* complex. (Abst.) Am. Phytopathol. Soc. Ann. Meet., Reno, Nevada. Phytopathology 75:1278.

Mallett, K.I.; Hiratsuka, Y. 1985. "Trap log" method to survey the distribution of *Armillaria mellea* in forest soils. Can. J. For. Res. Vol. 15.

Moody, B.H.; Cerezke, H.F. 1985. Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba and the Northwest Territories in 1984 and predictions for 1985. Inf. Rep. NOR-X-269.

Suzuki, K.; Mallett, K.I.; Hiratsuka, Y. 1985. Changes in water potential components in lodge pole pine seedlings inoculated with *Armillaria mellea*. (Abst.) Am. Phytopathol. Soc. Ann. Meet., Reno, Nevada. Phytopathology 75:1339.

Tsuneda, A.; Mallock, D.; Hiratsuka, Y. 1985. Ascospore morphology and germination in *Scopinella* species. Trans. Mycol. Soc. Jpn. 26:221--229.

Wong, H.R. 1985. Observations on the life history and habits of *Nematus calais* Kirby (Hymenoptera: Tenthredinidae) defoliating willows in Alberta. (Abst.) Proc. Entomol. Soc. Alta. 32:9.

Wong, H.R.; Drouin, J.A.; Rentz, C.L. 1986. *Petrova albicapitana* (Busck) and *Petrova* *metallica* (Busck) (Lepidoptera: Tortricidae) in *Pinus contorta* stands of Alberta. Can. Entomol. 117:1468–1470.

Zalasky, H. 1985. Bud defects in winter damaged Colorado spruce. Proceedings of the 33rd Annual International Forest Disease Work Conference, Olympia, Washington, Sept. 24-27. p. 110.

Pacific Forestry Centre

Alfaro, R.I.; Bloomberg, W.J.; Smith, R.B.; Thomson, A.J. 1985. Epidemiology of dwarf mistletoe in western hemlock stands in south coastal British Columbia. Can. J. For. Res. 15:909–913.

Alfaro, R.I.; Shore, T.L. 1984. Color video tape to record forest defoliation. J. Entomol. Soc. B.C. 81:19.

Alfaro, R.I.; Shore, T.L.; Wegwitz, E. 1984. Defoliation and mortality caused by western spruce budworm: Variability in a Douglas-fir stand. J. Entomol. Soc. B.C. 81:33-38.

Alfaro, R.I.; Thomson, A.J.; Van Sickle, G.A. 1985. Quantification of Douglas-fir growth losses caused by western spruce budworm defoliation using stem analysis. Can. J. For. Res. 15:5–9.

Amman, Gene D.; Safranyik, Les. 1985. Insects of lodgepole pine: impacts and controls. Pages 107-124 *in* Lodgepole pine — the species and its management. Symposium Proceedings. May 8-10, 1984, Spokane, Wash. and May 14-16, 1984, Vancouver, B.C.

Barclay, H.J. 1984. Pheromone trapping models for pest control: effects of mating patterns and immigration. Res. Popul. Ecol. 26:303–311.

Barclay, H.J.; Otvos, I.S.; Thomson, A.J. 1985. Models of periodic inundation of parasitoids for pest control. Can. Entomol. 117:705–716.

Barclay, Hugh J.; Van den Driessche, Pauline. 1984. Pheromone trapping for male annihilation: A density dependent model. Prot. Ecol. 7:281–289.

Bloomberg, W.J. 1985. The epidemiology of forest nursery diseases. Ann. Rev. Phytopathol. 23:83–96.

Bloomberg, W.J.; Reynolds, G. 1985. Growth loss and mortality in laminated root rot infection centers in second-growth Douglas-fir on Vancouver Island. For. Sci. 31:497–508.

Evans, David. 1985. Annotated checklist of insects associated with Garry oak in British Columbia. Inf. Rep. BC-X-262. 36 p.

Feller, M.C. 1985. Analysis of existing ecosystem chemistry data pertinent to the ARNEWS plot established near Spur 17 in the University of B.C. Research Forest. Can. For. Serv. Contract Rep. 91 p.

Fisher, M.E.; Van den Driessche, P.; Barclay, H.J. 1985. A density dependent model of pheromone trapping. Theor. Popul. Biol. 27:91–104.

Funk, A. 1985. An introduction to forest disease problems. Forest Pest Leaflet 54 (revised). 15 p.

Funk, A.; Woods, T.A.D.; Hopkinson, S.J. 1985. *Hormonema merioides* n. sp., on Douglas- fir needles. Can. J. Bot. 63:1579–1581.

Hall, A.A.; Bloomberg, W.J. 1984. A power-driven increment borer. For. Chron. 60:356–357.

Harris, J.W.E.; Alfaro, R.I.; Dawson, A.F.; Brown, R.G. 1985. The western spruce budworm in British Columbia 1909-1983. Infor. Rep. BC-X-257. 32 p.

Harris, J.W.E.; Dawson, A.F.; Brown, R.G. 1985. The western false hemlock looper in British Columbia 1942-1984. Infor. Rep. BC-X-269. 11 p.

Harris, J.W.E.; Dawson, A.F.; Brown, R.G. 1985. The Douglas-fir tussock moth in British Columbia 1916-1984. Infor. Rep. BC-X-268. 16 p.

Hawksworth, Frank G.; Gilbertson, Robert L.; Wallis, Gordon. 1984. Common names for tree diseases in the western United States and western Canada. Supplement to the Proceedings of the 32nd Annual Western International Forest Disease Work Conference, Taos, New Mexico. Sept. 25-28, 1984. 37 p.

Hopkins, J. 1985. Atropellis canker. Forest Pest Leaflet 25 (revised). 4 p.

Hopkins, J.C.; Lock, W.; Funk, A. 1985. *Colletotrichum acutatum*. A new pathogen on western hemlock seedlings in British Columbia. Can. Plant Dis. Surv. 65.11–13.

Hunt, R.S. 1984. Inoculations of *Scrophulariaceae* with *Cronartium ribicola*. Can. J. Bot. 62:2523–2524.

Hunt, R.S. 1985. *Leptomelanconium pinicola* comb. nov. and associated needle blight of pines. Can. J. Bot. 63:1157–1159.

Hunt, R.S. 1985. Experimental evidence of heterothallism in *Cronartium ribicola*. Can. J. Bot. 63:1086–1088.

Hunt, R.S.; Meagher, M.D. 1985. "How to recognize white pine blister rust cankers." Fact sheet. 2 p.

Miller, G.E.; Hedlin, A.F.; Ruth, D.S. 1984. Damage by two Douglas-fir cone and seed insects: correlation with cone crop size. Entomol. Soc. B.C. 81:46–50.

Moeck, H.A.; Safranyik, L.; Simmons, C.S.; Lawko, C.M. 1985. *Ips tridens* (Coleoptera: Scolytidae) attracted by Ipsdienol plus Cis-Verbenol. Can. Entomol. 117:955–960.

Morrison, D.J.; Thomson, A.J.; Chu, D.; Peet, F.G.; Sahota, T.S.; Tink, U. 1985. Isozyme patterns of *Armillaria* intersterility groups occurring in British Columbia. Can. J. Microbiol. 31:651–653.

Otvos, Imre S.; Stark, R.W. 1985. Arthropod food of some forest-inhabiting birds. Can. Entomol. 117:971–990.

Safranyik, L. 1985. Infestation incidence and mortality in white spruce stands by *Dendroctonus rufipennis* Kirby (Coleoptera, Scolytidae) in central British Columbia. Z. Angew. Entomol. 99:86–93.

Safranyik, L., ed. 1985. The role of the host in the population dynamics of forest insects. *In* Proc. of the IUFRO Conference, Banff, Alberta, Sept. 4-7, 1983. 8 p.

Safranyik, L.; Linton, D.A. 1985 The relationship between density of emerged *Dendroctonus ponderosae* (Coleoptera: Scolytidae) and density of exit holes in lodgepole pine. Can. Entomol. 117:267–275.

Safranyik, L.; Whitney, H.S. 1985. Development and survival of axenically reared mountain pine beetles, *Dendroctonus ponderosae* (Coleoptera: Scolytidae) at constant temperatures. Can. Entomol. 117:185–192.

Sahota, T.S.; Ibaraki, A.; Farris, S.H. 1985. Pharate-adult diapause of *Barbara colfaxiana* (Kft.):Differentiation of 1- and 2-year dormancy. Can. Entomol. 117:873–876.

Shepherd, R.E.; Gray, T.G. 1985. Pest management of Douglas-fir tussock moth, *Orgyia pseudotsugata* (Lepidoptera:Lymantriidae): monitoring endemic populations with pheromone traps to detect incipient outbreaks. Can. Entomol. 117:839–848.

Shepherd, R.F. 1985. Pest management of Douglas-fir tussock moth: estimating larval density by sequential sampling. Can. Entomol. 117:1111–1115.

Shepherd, R.F.; Otvos, I.S.; Chorney, R.J. 1985. Sequential sampling for Douglas-fir tussock moth egg masses in British Columbia. CFS/BCMF Joint Rep. 15. 7 p.

Shore, T.L. 1985. Ambrosia beetles. Forest Pest Leaflet 72. 4 p.

Shore, T.L.; McLean, J.A. 1984. The effect of height of pheromone-baited traps on catches of the ambrosia beetle, *Trypodendron lineatum*. J. Entomol. Soc. B.C. 81:17–18.

Shore, T.L.; McLean, J.A. 1985. A survey for the ambrosia beetles *Trypodendron lineatum* and *Gnathotrichus retusus* (Coleoptera:Scolytidae) in a sawmill using pheromone- baited traps. Can. Entomol. 117:49–55.

Sutherland, J.R.; Hopkinson, S.J.; Farris, S.H. 1984. Inland spruce cone rust, *Chrysomyxa pirolata*, in *Pyrola asarifolia* and cones of *Picea glauca* and morphology of the spore stages. Can. J. Bot. 62:2441–2447.

Thomson, A.J.; Alfaro, R.I.; Bloomberg, W.J.; Smith, R.B. 1985. Impact of dwarf mistletoe on the growth of western hemlock trees having different patterns of suppression and release. Can. J. For. Res. 15:665–668.

Thomson, A.J.; Smith, R.B.; Alfaro, R.I. 1984. Growth patterns in immature and mature western hemlock stands infected with dwarf mistletoe. Can. J. For. Res. 14:518–522.

Walmsley, M.E. 1985. Acid rain research and monitoring studies in British Columbia, Yukon and the U.S. Pacific Northwest; A review of ongoing and planned studies. Can. For. Serv. Contract Rep. 33 p.

Wood, C.S.; Van Sickle, G.A.; Shore, T.L. 1985. Forest insect and disease conditions in British Columbia & Yukon 1984. Info. Rep. BC-X-259. 32 p.

Headquarters

Dang, P.T. 1985. Key to adult males of conifer-feeding species of *Choristoneura* Lederer (Lepidoptera:Tortricidae) in Canada and Alaska. Can. Entomol. 117:1–5.

Philogène, B.J.R.; Arnason, J.T.; Berg, C.W.; Duval, F.; Champagne, D.; Taylor, R.G.; Leitch, L.C.; Morand, P. 1985. Synthesis and evaluation of the naturally occurring phototoxin, alpha terthrinyl, as a control agent for larvae of *Aedes intrudens, Aedes atropalpus* (Diptera:Culicidae) and *Simulium verecundum* (Diptera:Simuliidae). J. Econ. Entomol. 78:121–126.

Index to Insects, Diseases, and Damage

A

Page

- *Acantholyda erythrocephala* 45,46,77
- *Acaphyla distata* 39
- Acid rain 5,35,36-40
- *Acleris gloverana* 13,14
  - *variana* 52,58,71
- *Acrobeles* sp. 49
- *Actebia fennica* 47,70,85
- *Adelges abietis* 79
  - *cooleyi* 44,70,83,86
  - *lariciatus* 62,79
  - *piceae* 44,57
- *Agrilus anxius* 39
- *Agrotis ipsilon* 70
- Alder flea beetle 56,68
  - leaf beetle 52
  - leafminer 85
- *Allantonematidae* 49
  - Allegheny spruce beetle 85
- *Alsophila pometaria* 58,65,71,82
- *Altica ambiens alni* 56,68
  - *populi* 77
- Ambermarked birch leafminer 85
- American aspen beetle 68
- *Anacampsis innocuella* 56
  - *niveopulvella* 56
- *Anisota finlaysoni* 79
- *Annelid* sp. 50
- Anthracnose 52,68,85
- *Apanteles fumiferanae* 9
- *Aphelenchoides rhyntium* 49,50
- *Aphelenchoides* sp. 49,50
- *Aphelenchus* 49
- Aphids 46,56
- *Aphrophora cribrata* 46,77
  - *saratogensis* 78
- *Apiognomonia quercina* 68
- *Apiosporina morbosa* 52
- *Arceuthobium americanum* 33,47,82
  - *pusillum* 52,82
  - spp. 33-34
  - *tsugense* 86
- *Arge pectoralis* 69
- *Argyresthia aureoargentella* 57,70
  - *canadensis* 70
  - *freyella* 57
  - *laricella* 88
  - sp. 86
  - *thuiella* 57,70
- *Armillaria mellea* 9,46,50,56,68,82
- Armillaria root rot 7,9,46,47,50,56,68,82
- *Armillaria* sp. 47
- ARNEWS 36–40
- *Ascocalyx abietina* 46
  - sp. 85
- Ascocalyx canker 85
- *Asiphum* sp. 56
- Aspen leafblotch miner 68
  - leafrollers 56
  - serpentine leafminer 52,56,64
  - twoleaftier 64
  - webworm 56
- Atropellis canker 46,85
- *Atropellis piniphila* 46,85
- *Aureobasidium apocryptum* 68

B

- Balsam fir root aphid 56
  - gall midge 57
  - twig aphid 52,57
  - woolly adelgid 44,57
- Balsam fir sawfly 52,69
- *Barbara colfaxiana* 43
- Bark beetle 9
  - maggot 85
- Basswood looper 69
- Bedstraw hawkmoth 85
- Beech bark disease 57,64
- Beech scale 57,69
- Birch ambrosia beetle 39
- Birch–aspen leafroller 56
- Birch casebearer 52,57
  - lace bug 69
  - leafminer 52,57,69,79,82,85
  - sawfly 69
  - scale 39
  - skeletonizer 57,64,69,70
- *Biston betularia cognataria* 58
- Black army cutworm 47,70,85
- Blackheaded jack pine sawfly 65
- Black knot 52
- Black stain root disease 85
- Black willow leaf beetle 85
- Blowdown 57
- *Bromius obscurus* 55
- Bronze birch borer 39
- Broom rust 52,91
- Brown cubical rot 50
- Brown felt blight 86
- Browning 38,39,45
- Bruce spanworm 57,64,70
- *Bucculatrix ainsliella* 77
  - *canadensisella* 57,64,69
- *Bursaphelenchus* sp. 47–50
  - *xylophilus* 47,48,50,83
- Butt rot 50–51,78

C

- *Caenorhabditis* sp. 49
- *Caliciopsis pinea* 70
- *Caliroa cerasi* 83
  - *fasciata* 77
- *Callirhytis cornigera* 73
- *Caloptilia* sp. 59
- Canker 70
- *Cecidomyia resinicola* 46,73
- Cedar bark beetle 86
  - leafminers 57,70
  - tree borer 57
- *Cenangium ferruginosum* 80
- *Cenopsis acerivorana* 75
- *Ceratocystis ulmi* 29,64,71
  - *wagenerii* 85
- *Cercospora microspora* 74
- Chainspotted geometer 64
- *Cheilosia* sp. 85
- Chemical injury 82
- Cherry casebearer 57
- *Chionaspis pinifoliae* 46
- *Chondrostereum purpureum* 83
- *Choristoneura biennis* 13,83
  - *conflictana* 56,66,74,83,88
  - *fumiferana* 7
  - *occidentalis* 13
  - *orae* 13
  - *pinus pinus* 14,42,43,46,59
  - spp. 13
- *Chrysomela mainensis mainensis* 52
- *Chrysomyxa arctostaphyli* 91
  - *ledi* 61,76
  - *ledicola* 61,66,76
  - *pirolata* 44,53
  - *weirii* 89,91
- *Ciborinia whetzelii* 65,73
- *Cinara abieticola* 56
  - *banksiana* 56
  - *fornacula* 56
  - spp. 46
- *Cingilia catenaria* 64
- *Cladaria limitaria* 53
- *Clepsis persicana* 46
- *Clostera albosigma* 58
- *Cnephasia longana* 89
- *Coccomyces hiemalis* 54
- *Coleophora laricella* 53,59,65,74,82,87
  - *pruniella* 57
  - *serratella* 52,57
- *Coleosporium asterum* 46,54,60,76,89
  - *viburni* 60
- *Coleotechnites piceaella* 54
  - *thujaella* 57
- *Colletotrichum acutatum* 91
  - *gloeosporioides* 87
- Common June beetle 64
- Cone resin midge 42
  - rust 41
- Conifer micro moth, a 46
- *Conophthorus banksianae* 46,74
  - *coniperda* 81
  - *resinosae* 42,43,78
- *Contarinia baeri* 46
  - *oregonensis* 86
  - *washingtonensis* 86
- Cooley spruce gall adelgid 44,70,86
- *Corythucha pallipes* 69
  - *ulmi* 65
- *Croesia semipurpurana* 61,76
- *Cronartium coleosporioides* 47
  - *comandrae* 47
  - *comptoniae* 46
  - *ribicola* 80
- *Cryptaphelenchus* spp. 49,50
- *Cryptococcus fagisuga* 57,69
- *Cryptorhynchus lapathi* 89
- *Cydia strobilella* 41,44
- *Cylindrocladium floridanum* 67
- *Cylindrosporium betulae* 53
- Cypress tip moth 86
- Cytospora canker 82
- *Cytospora chrysosperma* 82

D

- Darkheaded aspen leafroller 56
- *Datana integerrima* 80
- *Davisomycella ampla* 46,76
- Decline 34–35
- *Deladenus* sp. 49,50
- *Delia anthracina* (see *Hylemya anthracina*) 44
- *Delphinella balsameae* 62
  - spp. 91
- *Dendroctonus murrayanae* 88
  - *ponderosae* 16
  - *pseudotsugae* 50,86
  - *punctatus* 85
  - *rufipennis* 18
  - *simplex* 20
- Deterioration of white birch 35,38-40
- *Didymascella thujina* 88
- Dieback 34–35,58,64
- *Dioryctria abietivorella* 41,42,43,44
  - *disclusa* 42,43
  - *reniculelloides* 54,62,79
  - *resinosella* 78
- Diplodia canker 70
- *Diplodia juglandis* 70
- *Diploscapter* sp. 49
- *Diprion similis* 73,82
- Discocainia canker 86
- *Discocainia treleasei* 86
- *Discula campestris* 68
- *Dothistroma pini* 54
- *Dotylaphus* sp. 49
- Douglas-fir beetle 50,86
  - cone moth 43
  - cone scale midge 86
  - coneworm 41,42,43
  - gall midge 86

  seed chalcid 44
  tussock moth 86
Drepanopeziza tremulae 59
Drought damage 70,71
Dryocoetes confusus 91
Dutch elm disease 29,64,71
Dwarf mistletoes 33-34,48,52,82,86

E

Early birch leaf edgeminer 71
Eastern blackheaded budworm 52,58,71
  dwarf mistletoe 52
  pine seedworm 42
  pine shoot borer 46,71
  tent caterpillar 58,71
Ectoedemia lindquisti 79
Ektaphelenchus sp. 49
Elatobium abietinum 44,90
Elm lace bug 65
  leaf beetle 58
  leafminer 58
Elytroderma deformans 86,88
Elytroderma disease 86
Enargia decolor 64
Endocronartium harknessii 46,47,59,80,83,91
Entomophaga aulicae 9,27
Epinotia aceriella 75
  criddleana 56
  solandriana 56
Erannis tilaria tilaria 69
Eriocampa ovata 92
Eriococcoidae 61
Eriophyid mite, an 39
Erwinia amylovora 72,82
Eucosma gloriola 46,71
  monitorana 41,42,78
  sonomana 91
  toreuta 42,43
Eupareophora parca 79
European alder leafminer 52,71,87
  false underwing (see yellow underwing) 63
  larch canker 32–33,87
  pine needle midge 46
  pine sawfly 45,58,71
  pine shoot moth 45,52,58,71,87
  spruce sawfly 5,52,58,82
Eutypella canker 71
Eutypella parasitica 71
Exoteleia dodecella 46

F

Fall cankerworm 58,65,71,72,82
  webworm 52,58,65,72,87
False hornworm 58
Fenusa dohrnii 52,71,87
  pusilla 52,57,69,82
  ulmi 58
Feralia jocosa 54
Filenchus sp. 50
Fir budmoths 87
Fire blight 72,82
Flat leaftier 72
Fletcher scale 72
Flood damage 58
Fomes pinicola 50,51
Fomes root rot 72
Forest tent caterpillar 24-26
Formica sp. 75
Foureyed spruce bark beetle 9,50,53
Frost damage 72,82,87
Frost heaving 72
Fusicladium saliciperdum 54
Fusicoccum abietinum 54

G

Gall rust 46,59,80,83,91
Gelechiidae 42
Gilpinia hercyniae 52,58,82
Globose gall rust 59,72
Gloeosporium sp. 85
Glomerella blight 87
Glypta fumiferanae 9
Gonioctena americana 68
Gonomonia leptostyla 68
Gray willow leaf beetle 72
Green balsam looper 53
Greenheaded spruce sawfly 53
Greenstriped forest looper 87
Gremmeniella abietina 29,30,32,83
Guignardia aesculi 59,74
Gymnosporangium globosum 72
Gypsy moth 20-24

H

Hail damage 65,72
Hemichroa crocea 55,62,91
Hemlock looper 27-28
Hemlock-willow foliar rust 87
Herpotrichia juniperi 86
Heterarthrus nemoratus 82
Heterobasidion annosum 72
Heterocampa guttivitta 61
Hexatylus sp. 49
Hirsutella gigantea 9
Holcocerina immaculella 46
Horned oak gall wasp 73
Hylemya anthracina 44
Hyles gallii 85
Hylobius congener 62
  radicis 77,83
  sp. 54
  warreni 46
Hylurgopinus rufipes 29
Hyphantria cunea 52,58,65,72,87
Hypodermella laricis 88
Hypogymnia physoides 60
Hypoxylon canker 73,82
Hypoxylon mammatum 73,82

I

Ice storm damage 65,82
Ichneumonid wasps 47
Ink spot 65,73
Inland spruce cone rust 53
Introduced pine sawfly 73,82
Ips perturbatus 51,89
  pini 83,89
Ironotus tomentosus 78
Isthmiella faullii 54
Itame pustularia 60

J

Jack pine budworm 14-16,42,46,59
  pine resin midge 46,73
  pine sawflies 65,73
  pine tip beetle 46,74
  pine tube moth 46

K

Kabatiella apocrypta 52
Kabatina thujae 76

L

Lachnellula willkommii 32,33,87
Laimaphelenchus sp. 49,50
Lambdina fiscellaria fiscellaria 27
  fiscellaria lugubrosa 91
  fiscellaria somniaria 91
Larch budmoth 66,87
  casebearer 53,59,65,66,74,82,87
  needleworm 59,66
  sawfly 20,53,59,74,83,87
  shoot moth 88
Large aspen tortrix 56,66,74,83,88
Laspeyresia youngana (see *Cydia strobilella*) 41,44
Leaf and twig blight 59
Leaf blight 53,74
Leaf blister 53
Leaf blotch 59,74
Leaf drop 38
Leafrollers on birch 59
Leaf rusts 53,59,66,74,88
Leaf spot 53,59,74,75
Leaf spot fungus 38,39
Leather-winged beetles 88
Leptomelanconium pinicola 88
Leptosphaeria sp. 90
Leptostroma sp. 76
Lesser aspen webworm 56
Lesser maple spanworm 60
Leucoma salicis 54,61,79,90
Lichens 60
Lightheaded aspen leafroller 56
Linospora tetraspora 74
Lirula nervata 60
Lithocolletis sp. 85
Locust borer 75
Lodgepole pine beetle 88
Lodgepole pine dwarf mistletoe 33,47
  terminal weevil 83,88
Lophocampa argentata 90
  maculata 90
Lophodermella concolor 88
  montivaga 88
Lophodermium nitens 66
  pinastri 54,66
  seditiosum 76
  sp. 46,76,88
Lymantria dispar 20
Lyonetia saliciella 85
  sp. 66,84

M

Macrolaimus sp. 49,50
Malacosoma americanum 58,71
  californicum 92
  disstria 24
Maple dieback 34–35
  leafcutter 66,75
  leafroller 60,75
  tar spot 60
  trumpet skeletonizer 75
  webworm 75
Marssonina brunnea 74
  juglandis 74
  populi 74
Megacyllene robiniae 75
Megastigmus specularis spermotrophus 44
Melampsora abieti-capraearum 60
  epitea 74,87
  medusae 59,88
  occidentalis 88
  sp. 60
Melampsorella caryophyllacearum 52,63
Melampsoridium betulinum 53
Melanolophia imitata 87
Meria laricis 76
  sp. 44
Meria needle disease 44
Meroptera pravella 56
Mesorhabditis sp. 49
Microstroma juglandis 80
Micrurapteryx salicifoliella 81
Milesina sp. 60
Minute egg parasite 45
Mites 39,60
Monochamus scutellatus 67
Monochoides sp. 49
Mound ant 75
Mountain-ash sawfly 53,60,75
Mountain pine beetle 16-18
Mourningcloak butterfly 53
Mycosphaerella effigurata 74
  populi 75
  populicola 75

N

- Native elm bark beetle 29
- Nectria canker 54
- *Nectria cinnabarina* 54
  - *coccinea* var. *faginata* 57,64
- Needle blight 60,76,88
- Needle casts 46,54,60,66,76,88
  - rusts 46,54,60,61,66,76,89
- Nematode 49,50
- *Nematus ventralis* 55
- *Neodiprion abietis* complex 52,69
  - *lecontei* 45,66,78
  - *maurus* 46,73
  - *nanulus nanulus* 46,67,78
  - *pratti banksianae* 65,73
  - *pratti paradoxicus* 73
  - *rugifrons* 46,78
  - *sertifer* 45,58,71
  - spp. 90
  - *swainei* 67,80
- *Neoditylenchus* sp. 49
- *Neotylenchus* sp. 49
- *Nephopteryx subfuscella* 80
- *Nepytia freemani* 91
- *Noctua pronuba* 63
- Northern pitch twig moth 46,61,83
  - spruce engraver beetle 51,89
- *Nosema fumiferanae* 9
- *Nymphalis antiopa* 53,79

O

- Oak leafmining sawfly 76
  - leafshredder 61,76
  - skeletonizer 77
  - slug sawfly 77
- *Oligonychus ununguis* 62,67,83
- Omnivorous leaftier 89
- *Operophtera bruceata* 57,64,70
  - *brumata* 63,92
- Orangehumped mapleworm 61,66
- Orange spruce needleminer 54
- Orange stalactiforme blister rust 47
- *Orgyia antiqua* 54
  - *leucostigma leucostigma* 62
  - *pseudotsugata* 86
- *Otiorhynchus raucus* 79

P

- Pacific willow leaf beetle 89
- *Paecilomyces farinosus* 9
- *Paleacrita vernata* 62
- *Panagrellus* sp. 49
- *Panagrobellus* sp. 49
- *Panagrolaimus* sp. 49
- *Paphelenchoides* sp. 49
- *Paraclemensia acerifoliella* 66,75
- *Paradiplosis tumifex* 57
- *Paraprociphilus americanus* 56
- *Parasitaphelenchus* sp. 49
- *Parasitorhabditis* sp. 49
- *Parasitylenchus* sp. 49
- *Paurodontus* 49
- Pear sawfly 83
- *Pelodera* 49
- *Pemphigus* sp. 56
- Pepper-and-salt moth (see false hornworm) 58
- *Petrova albicapitana* 46,61,83,89
  - *metallica* 83,89
  - sp. 47
- *Phacidium infestans* 54
  - *sherwoodiae* 90
- *Phaeocryptopus gaeumannii* 44,60,88
- *Phaeogenes hariolus* 9
- *Phellinus weirii* 50
- *Pheosia rimosa* 58
- *Phloesinus cupressi* 6
- *Phyllocnistis populiella* 52,56,64
- *Phyllocolpa bozemani* 89
- *Phyllonorycter ontario* 68
- *Phyllophaga* sp. 64
- *Phyllosticta minima* 75
- *Physalospora miyabeana* 54
- *Pikonema alaskensis* 55,63,81,84
  - *dimmockii* 53
- Pine adelgids 89
  - bud moth 46
  - engraver 83,89
  - false webworm 45,46,77
  - gall weevil 77
  - leaf adelgid 61
  - needle rust 46
  - needle scale 46
  - needle sheathminer 46,77,89
  - root collar weevil 77,83
  - sawfly 46
  - spittlebug 46,77
  - tortoise scale 46
  - webworm 46
  - wilt disease 47
  - wood nematode 47-50,83
- *Pineus pinifoliae* 61,83
  - *similis* 79,83
  - spp. 89
- *Pissodes strobi* 46,63,81,84,92
  - *terminalis* 83,88
- Pitch nodule makers 89
- Pitch twig moth 47
- *Pityophthorus* sp. 91
- *Podabrus* sp. 88
- *Podapion gallicola* 77
- *Pollaceia elegans* 53
- *Polygraphus rufipennis* 9,53
- *Polyporus tomentosus* 50
- Poplar-and-willow borer 89
- Poplar flea beetle 77
  - leaffolding sawfly 89
  - leafminer 66
  - leafmining sawfly 78
  - shoot blight 89

- Porcupine damage 61,83
- *Poria subacida* 50,51
- Powdery mildew 78
- *Pristiphora erichsonii* 20,53,59,74,83,87
  - *geniculata* 53,60,75
- *Profenusa lucifex* 76
  - *thomsoni* 82,85
- *Pseudexentera cressoniana* 61
  - *oregonana* 56
- *Pseudhalenchus* sp. 49
- *Pseudosciaphila duplex* 56
- *Psilocorsis reflexella* 72
- *Pterocomma smithiae* 56
- *Puccinia sparganioides* 59
- *Pucciniastrum americanum* 41
  - *epilobii* 54,60
  - *goeppertianum* 60
  - *sparsum* 66
- *Pulicalvaria thujaella* 70
- *Pyrrhalta decora carbo* 89
  - *decora decora* 72
  - *luteola* 58
  - *punctipennis* 85

R

- Rabbit damage 83
- Red band disease 89
- Red belt injury 83
- Red butt rot 50
- Red flagging 54
- Redheaded jack pine sawfly 46,78
  - pine sawfly 45,66,67,78
- Redlined conifer caterpillar 54
- Red oak decline 35
- Red pine cone beetle 42,78
  - pine coneworm 41,42,78
  - pine sawfly 46,67,78
  - pine shoot moth 78
- *Rehmiellopsis balsamae* 55
- *Resseliella* sp. 42
- *Rhabditidae* 50
- *Rhabditis* sp. 50
- *Rhabdocline* sp. 60,88
- *Rhabdontolaimus* sp. 49
- *Rhabdophaga swainei* 54
- *Rheumaptera hastata* 79
- Rhizina root rot 47
- *Rhizina undulata* 47
- *Rhynchaenus rufipes* 63
- *Rhytisma acerinum* 60
  - *salicinum* 80,91
- Rodent damage (porcupine, squirrel) 47,89
- Root and butt rot 78
- Root collar weevil 54
- Root rot 7,9,46,48,50-51,56,67,68,72,78,82
- Rustylined leaftier (see false hornworm) 58
- Rusty tussock moth 54

S

- Saddled prominent 61
- Salt damage 61,78,89
- Saratoga spittlebug 78,79
- Satin moth 54,61,79,90
- Sawflies 90
- Scab and black canker 54
- Scale insects 61,62
- Scleroderris canker 29-32,46,83
- *Scirrhia pini* 89
- Scorch 79
- Secondary fungus 90
- Seedling-debarking weevil 62
- Seedling weevil 90
- *Semanotus ligneus* 57
- *Septoria betulae* 53
  - *betulina* 38,39
  - *musiva* 53
- Sequoia pitch moth 90
- Shoot blight 53,79
- Shorthorned oakworm 79
- Shot hole 54
- Silver leaf 83
- Silverspotted tiger moth 90
- *Sirococcus conigeus* 44,45
- Sirococcus shoot blight 44,45,54
- *Sirococcus strobilinus* 44,45,54
- Small birch leafminer 79
- Snout weevil 79
- Snow blight 54
- Snow breakage 90
- Snow mold fungi 90
- Snowshoe hare 47,90
- *Sparganothis acerivorana* 60
- Spearmarked black moth 79
- *Sphaeropsis sapinea* 42,43,80
- *Sphaerularia* sp. 49
- Spiny ash sawfly 79
- Spiny elm caterpillar 79
- Spotted aspen leafroller 56
  - tussock moth 90
- Spring cankerworm 62
- Spruce aphid 44,90
  - beetle 7,18-20,85
  - broom rust 91
  - bud midge 54
  - budmoth 45,67
  - budworm 5,7-13,14,27,48,50
  - cone maggot 41,44
  - cone rust 44
  - coneworm 54,62,79
  - gall adelgid 62,79,83
  - needle rust 91
  - seed moth 41,44
  - spider mites 62,67,83
- *Steremnius carinatus* 90
- *Stereum purpureum* 83
- Striped alder sawfly 55,62,91

  sumac leafroller 80
Swaine jack pine sawfly 67,80
Sweetfern blister rust 46
Swiss needle cast 44
Symmerista leucitys 61,66
Synanthedon sp. 90

T

Tachinid flies 47
Taphrina populina 53
Tar spot 80,91
Terminal crook disease 91
Tetralopha aplastella 56
  asperatella 75
  robustella 46
Tip blight 42,55,62,80,91
Toumeyella parvicornis 46
Tree mortality 62
Trypodendron betulae 39
Twig beetle 91
Twig blight 80
Two-year-cycle spruce budworm 83

U

Uncinula flexuosa 78
Uredinopsis sp. 60

V

Venturia macularis 53,59,79,89
  saliciperda 63
Verticillium albo-atrum 80
Verticillium wilt 80

W

Walnut caterpillar 80
Warren's root collar weevil 46
Water damage 80
Wax filament scale 62
Webbing coneworm 42
Weevil, a 46
Western balsam bark beetle 91
  false hemlock looper 91
  gall rust 47,80,83,91
  grape rootworm 55
  hemlock looper 91
  oak looper 91
  pine shoot borer 91
  spruce budworms 13-14
  tent caterpillar 92
Whitemarked tussock moth 62
White mold 80
White pine blister rust 80
  pine cone beetle 81
  pine coneworm 42
  pine needle blight 62,63
  pine weevil 46,63,81,84,92
Whitespotted sawyer 67
White stringy rot 50
Whitetriangle tortricid 46
Willow blight 63
  flea weevil 63
  leafminer 81,84
  sawfly 55
Wind damage 81
Windfall 67
Winter drying 55,63,81,84,92
Winter moth 63,92
Witches' broom 33
Woolly alder sawfly 92

X

Xanthoria 60
Xylococculus betulae 39,62

Y

Yellowheaded spruce sawfly 55,63,81,84
Yellow underwing 63
Yellow witches'-broom 63

Z

Zeiraphera canadensis 45,67
  improbana 59,66,87
  spp. 87
  unfortunata 45
Zelleria haimbachi 77,89